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PLANNING THE LAND FOR THE FUTURE[1]

By Professor L. DUDLEY STAMP

DIRECTOR OF THE LAND UTILIZATION SURVEY OF BRITAIN

SOME apology is needed for my appearance on this platform to-night in the presence of those much more directly concerned with the subject-matter of my address, for I am in this country as a student and not as a lecturer. There are so many aspects of land planning which have been so successfully considered here—I may refer, for example, to the magnificent series of national and state parks—and the subject in relation to the economic difficulties of the present time is one so much to the fore in America that it is only natural for a European to come here to attempt to observe and learn. As director of the Land Utilization Survey of Britain—a survey that aims at making a record of the present use of every single acre of England, Wales and Scotland as a basis for comparison with the past and of planning for the future—I have been close to the problems of land planning in Britain for the past three years and seized with avidity the invitation extended by Dr. Isaiah Bowman, chairman of the National Research Council, to spend a year in America in order to get an international view-point on the problems of land planning before preparing any report on the British Survey. My observations will thus be influenced by a comparison of conditions in Europe, especially Britain, with what I have seen in the course of the past year in 47 out of the 48 states of the Union as well as in Canada, the West Indies and in ten of the countries of South America. But I offer these observations in a spirit of inquiry and not as fixed precepts.

[1] The Hector Maiben Lecture of the American Association for the Advancement of Science, delivered at Berkeley, California, June, 1934.

THE APPROACH TO PLANNING

The land is the heritage of all. It does not matter whether or not we own a tract of the earth's surface, whether or not we are directly concerned with the

business of wresting from nature the fruits of the earth. Whatever our nationality, whatever our occupation, for most of us our mortal life is lived on the surface of the earth. As nations the land is the one ultimate asset that we have: as individuals it is upon the surface of the land, its natural beauties or its man-made ugliness, that we are compelled to gaze most of our waking hours. It is in this sense, without any question of ownership, that planning the land is the concern of everybody. No one who has driven for months, as I have done, through the length and breadth of the United States, could fail to be impressed by the size of the country, by the vast areas involved. But, however vast, one is impressed by the fact that everywhere, from Atlantic to Pacific, the land is known, there are no new areas awaiting discovery. The same is surprisingly true of the whole world. Some years of my life I spent in the rather remote country of Burma in a search for oil and minerals. With only one entry available for modern transport for an area of a quarter of a million square miles, with much of its area accessible only by bullock carts limited to 15 miles a day or by mule back, even a thousand miles up-country from Rangoon one finds a country organized, even sophisticated to the extent of knowing jazz from an ancient Victrola. Again the impression that the Age of Discovery is over. We may indeed truthfully say that the Age of Consolidation has succeeded the Age of Discovery. With so much of this country but a couple of generations removed from the days of the covered wagon, we scarcely need to be reminded that when settlement was made in a new area, pioneering was the job of every one who went into that area. It could not be left to the few. So to-day the work of consolidation is the concern of everybody; we are all of us land-planners. By the care or lack of care which we bestow on the lot surrounding our home we can please or offend the eye of the passer-by; by our appreciation or otherwise of the public parklands we influence the thoughts and actions of those we appoint as professional land planners; by the numbers of empty cans we leave behind we influence the value of a camp site or a beauty spot to the nation at large. Planning the land for the future is essentially the work of securing the optimum use for the benefit of all. Every one has a share, but none must have a dominant voice. It is essential to balance the often conflicting claims of the farmer, forester, miner, industrialist, home-owner, traveler, pleasure-seeker; to secure a balance between town and country development, between the economic and esthetic needs of the nation. Too often the work of planning the land for the future is regarded as exclusively the province of the town planner who is concerned solely with urban growth: alternately it is considered as the work of the agricultural economist who is concerned with production. Actually, successful and lasting land planning must be a cooperative work carried out for the benefit of all and made possible by the good-will of all.

The Seven Stages of Planning

Shakespeare has immortalized for us the seven ages of man, a succession of stages in human development as true to-day with but minor variations as three hundred years ago. I believe that a successful planning of the land will proceed by stages and that there is an inherent danger, too apt to be overlooked to-day, of passing over any one of those stages. It will not do to push the analogy too far, for one hopes that the final stage of planning will not resemble the final stage of senile decay in the human being.

In the first place, there must be the recognition of the need for planning. Many arguments may be used to prove the need, but it is both interesting and important to note that different appeals may be made, adapted to different types of psychology. The building of the Norris Dam in the Tennessee Valley area will result in the formation of a large lake and the submergence of a bridge built but three years previously at a cost of about a million dollars. This fact may be used to demonstrate the possible waste of public money when a long-range plan is absent. A social worker may be appalled at the sight of New York's children playing in an uptown cross-street, motor traffic being asked to avoid the "play-street" as far as possible. It is a state of affairs which may be used to illustrate the need for town planning which shall consider the recreational needs of the people. Who has not seen a pleasant residential area ruined by the erection of a factory in its midst? The real estate man is often, quite unjustly, regarded as the enemy of planning. Where he sees possibilities of profit disappearing he may be, but in such a case he suffers, together with the residents, through the absence of planning. A tract of land, too poor for farming, may have little value as a whole for real estate development, but put a high-speed parkway through it with restricted frontage rights (as Westchester County of New York State has done) and note the jump in value of the adjoining land. Thus the recognition of the need for planning will depend upon the individual point of view.

The second stage in planning is education—the education of the people to see the need or, expressing it more bluntly, "selling the idea." It will be clear that the appeals to be made will vary with the audience, but let us always look upon land planning as something lasting, something which after all will not be accomplished in a moment but which depends upon continued cooperation for its success. What, then, can be more important than that the rising generation

the children in the schools, should be made familiar with the idea of planning? It is a very essential part of their training as citizens, and children are quick to learn how they can do their share to ameliorate existing conditions. It may only be keeping tidy the vicinity of their school, but a local pride is not too difficult to foster. I have in mind the very delightful campus of a large training college in one of the eastern states. The grass is green and smooth, yet there are no fences, no commands to "stay out." Instead is expressed the desire of the planner and the reason—"Don't cross here, keep the campus beautiful." Selling the idea to the children does not mean preaching against the existing order. It can combine respect for what has already been done with the desire to carry on the work of those pioneers by increasing efficiency and beauty.

But in talking about the educational aspect we have rather overrun the third stage—the all-important stage of research into the problems involved. The proper utilization of the land must depend primarily on the potentialities of the soil. The utilization of any given area may vary from time to time within certain limits according to the economic requirements of the moment or may be profoundly changed by alterations in the facilities for communication or transport. There is a very real danger that the urgency of formulating plans for immediate adoption consequent upon the economic depression may blind us to the fundamental natural factors which must always exercise a controlling influence on land utilization. There is no short cut; nothing can remove the necessity for the painstaking scientific investigation of climate, soil and vegetation cover, to mention but the chief of the natural factors involved. Such investigations are concerned with factors which will be operative a hundred years hence when the economic set-up may be completely changed.

Research into both the geographic and economic factors involved should lead to the fourth stage, the formulation of a plan of development, but this stage is incomplete without the thorough examination of the plan. Whilst scientists are popularly regarded as above the petty human emotions, there is yet a lurking fear that they are not entirely free from a degree of jealousy. In planning the land one investigator is so apt to consider his point of view as the only really significant one; the agriculturist is apt to be so obsessed by the significance of soil fertility that he may be shocked to find the town planner has not even considered this factor and had lightly chosen (unwittingly, of course) an area of finest alluvial soil as the area for industrial development. So any plan must be thoroughly discussed from all angles and a united front presented before entering on the fifth stage—education and publicity. I am convinced that successful planning is planning for the benefit of the majority; in a democratic country there is nothing to be feared in putting such a plan before the public. I am aware that vested interests and political considerations may at times intervene. But Wisconsin has made a success of going to the people with its plans, county by county, and opponents have become staunch supporters. In the work of publicity the press has an enormous influence. All too frequently scientific workers and planners are to blame in failing to present their material in such a way that it can be used by the newspapers. Planners would do well to note the enormous success of President Roosevelt's broadcast talks.

I will pass lightly over the sixth stage—the necessary legislation—because I believe that so much depends on the adequacy of the work in the preceding stages. There will be no difficulty in securing the passage of the necessary measures if the ground has been well prepared. The legislation is not concerned primarily with ownership but with the course of development. The final stage is execution and administration, where the keynote of success is popular cooperation. Who has not observed the delightful results of friendly rivalry between neighboring home-owners in the attempt to beautify their gardens? Too often in a village all are apathetic; but let three or four launch an attempt at improvement, the influence of their movement will soon be apparent throughout. Successful land planning must depend in just the same way on the spontaneous development of public interest, independently of financial considerations.

THE LAND UTILIZATION SURVEY OF BRITAIN

In suggesting that the work of planning the land for the future should proceed by a regular succession of stages I hope that I shall not be accused of suggesting what is desirable rather than what is practicable. I may be pardoned, perhaps, for referring to the work of the Land Utilization Survey of Britain, where some attempt has been made to put precept into practise. The bare 100,000 square miles of England, Wales and Scotland can not produce the quantity even of essential foodstuffs necessary to feed the 45,000,000 people of the area. Britain lives by selling her manufactured goods in the world's markets and, aided by her carrying trade and overseas investments, buys with the proceeds some 60 per cent. of all the food she consumes. The world-wide growth of nationalism makes such a national position as Britain's inherently difficult and may—indeed is—forcing Britain to a more intensive development of home resources. Hence the urgent necessity of recording, field by field, the present utilization of the land so that the relative importance of the factors influencing utilization—whether natural or geographic (*e.g.*, soil)

or economic—may be adequately studied area by area. Statistical comparisons fall short of what is required in that it is not possible without detailed mapping to correlate soil with crop and yield unless the area on the ground is known and mapped. Hence the recognition of the need and the aim of this "modern Domesday Survey" to record the use of every single acre of the surface. Such a record serves as a standard of comparison with the past and a basis of planning for the future, but there is the parallel need of interesting the people as a whole in the land and its problems. Hence the idea of getting the work carried out as an educational exercise in the colleges and schools. Britain is fortunate in the possession of a magnificent series of base maps—published by the Ordnance Survey, the central government map-making department—on the scale of six inches to one mile. These show buildings, roads and field boundaries (though they fall short of United States standards of topographical detail) and the work of the land-use surveyor is to record on each lot its present use. The six-inch maps are published in "quarter sheets," covering an area of three miles by two. The task may appear simple, but 22,000 of these sheets are required to cover Britain, and the work of securing 22,000 volunteers, all working along the same lines, was not an easy one.

The survey was organized on a county basis; in each county the director of education was asked to act as county organizer and each school was asked to be responsible for its own home area with the colleges and senior students undertaking areas more difficult in character or of access. There is little doubt that all over the country the interest of the young people in their land and its problems has been aroused; their parents, especially the farmers, took an active interest, friendly rivalry between neighboring schools (fostered occasionally by the offer of a small prize) was aroused and resulted in a surprisingly high degree of accuracy. In securing this "snap-shot" picture of the country in the years 1931 to 1934 it is estimated that 10,000 teachers and 250,000 children took part, and 85 per cent. of the whole area was covered by these youthful volunteers. But research had to precede as well as follow this work. First, advice was sought from official and unofficial bodies representing farmers, foresters, large land-owners, town planners, educationalists, local government authorities and others as to what information should be collected. Then (bearing in mind the unskilled helpers it was proposed to use) several simple schemes of land classification were drawn up and tried out in the field until one was found as near satisfactory as possible. This scheme was then embodied on a single leaflet, of which some 60,000 were used, thus securing uniformity. The record of the field work is contained in the file of manuscript-covered base maps and is the "raw material" which requires editing, reduction to the uniform scale of one inch to one mile and careful study before it can be used as the basis for planning.

In Britain much of the land has been used for many centuries and it is often true that nature has already dictated the proper use of the land—in any case existing land use is the result of the interaction of a variety of factors and is often indicative of the potentialities of the land. Successful land planning in Britain must start—as indeed it must in all countries—from the existing land uses and attempt to mould the development along sound lines; it must seek to disturb as little as possible the existing position. The town or country planner can not treat the country as if it were a blank sheet of paper, but must seek to develop gradually from the present position disturbing only the minimum number of interests in the process of development. The largest town-planning scheme in Scotland—that for Aberdeen—well shows this, whilst the use of a detailed land-use map as a basis of planning is shown in the schemes for North Wales and East Suffolk. This is the stage which may be called the formulation of the plan, but the Land Utilization Survey is attempting to do its share of publicity work by bringing the results of its work before the general public. The maps, on the scale of one inch to one mile, printed in attractive colors on waterproof paper, mounted on linen and folded in covers, give the tourist, the hiker or the motorist (who isn't in too much hurry) an almost complete picture of the countryside so that he can plan his trips to the greatest advantage. These maps are on public sale and are also being exhibited by several of the transport companies to show the attractive nature of country served by their round trip tickets. The honest realtor is beginning to discover that they can be used to demonstrate the delightful spots readily accessible from the property he is attempting to sell. His less honest rival can not do this. The Land Utilization Survey is not concerned with legislation and execution. In the Town and Country Planning Act, the legislation exists: the great task for the scientific investigator is to have his facts collected ready and properly marshalled for the administrator.

Good and Bad Planning

The last remark leads me to refer to what I believe to be the greatest present danger before the planner. It is that plans will be formulated and put into operation without an adequate study of the factors involved—that planning will overtake research.

A planned development can be just as defective as a development which depends on individualistic enterprise under a policy of *laissez-faire*. Indeed it can be far worse. For individualistic development is dictated

by the hope of personal advancement and takes places according to the individual's concept of future trend. A man believes a town is going to grow. He puts up a large hotel or indulges in real estate speculation. If his belief is wrong he is likely to lose heavily. The planner who plans according to mere beliefs has little to lose except other people's money and his own reputation. At the present time the world is passing through a period of severe depression. Plans based on the economic position of the moment are likely to be bad plans. So are plans which are purely national or local. Just at present it seems clear that Britain and the United States are tending to develop in opposite directions. In Britain the burning question is how can we make more effective use of our land, how can we increase agricultural production so as to be more nearly self-supporting. This point of view is common to many, if not all, of the nations of Europe. In the United States, on the other hand, attention is of necessity directed towards the evils of "over-production," the burning question is how to limit agricultural production and retire to other uses the poorer types of cultivated land. Such a state of affairs can only be possible in a thoroughly protectionist world. What of the future? Are our schemes of land planning to depend on the continuance of present tariff barriers? It has often been said that the United States constitutes the largest federation of free-trade nations in the world and, as a single great economic unit, can act independently of the rest of the world. But even as no man liveth unto himself and none dieth unto himself so we may say that no nation liveth unto itself and none dieth unto itself.

Modern improvements in transport and communications have made the world, whether we will it or not, a single unit, and I firmly believe that the progress and prosperity of any one part depends on the peace, progress and prosperity of the whole. It requires but a moment's calculation to show how minute changes in one part of the world may affect the whole course of world requirements and world trade. There are in India 350,000,000 people, of whom some 200,000,000 may be classed as potential or actual wage-earners. Yet the majority live but little removed from the starvation level at an average income probably not exceeding 16 or 18 cents a day. Let us just suppose that their earning capacity could be increased by the munificent sum of two cents per day. By this tiny change $1,000,000,000 would become available annually for the purchase of goods in the world's markets. Or take another example. The people of Britain with an extremely varied diet nevertheless consume an average of 3½ bushels of wheat per head per annum. The Chinese at present live for the most part on the starvation level, but where opportunities allow it is clear that they are developing a taste for wheat as their chief food grain. If they became as hungry as the British they would require roughly twice the total quantity of wheat produced in the whole of the United States. Even a moderate requirement of one bushel per head per annum would produce a new world demand of over 400,000,000 bushels. Of what use is it to classify huge tracts of land as not required for agriculture when such changes as these may be in course of happening at this very moment? Rather let us seek to learn the potentialities of our land, for all good planning must be long-range planning. For long-range planning there must be full and adequate study of two sets of factors:—(a) The natural background—topography with water supply, soil, climate, natural vegetation, wild life and existing utilization; in many ways the vegetative cover, natural and artificial, is the most important, for it affords an index of the interaction of the other factors. (b) Social and economic trends—the changing habits of mankind, whether it be the desire for smaller families, for new uses of increasing leisure or the development of a new sense of values including the esthetic.

It is sometimes said that the natural or geographic factors are no longer of importance, the economic factors are the only significant ones. The reverse is nearer the truth. A hundred years ago the people living in the wetter west of England, if they desired wheaten bread, had of necessity to grow their own wheat. But the dampness of the climate rendered the harvest uncertain and to-day, with foreign supplies from countries whose natural conditions are far more suitable, wheat is no longer grown. In other words, the geographical factors are influencing utilization to-day as they never did before. Incidentally, this example serves to suggest the folly of the artificial stimulus by legislation of the cultivation of crops for which a country is not suited by nature—economic development which is opposed to natural development is bound to fail in the long run.

It must not be concluded from the foregoing remarks that planning is useless because it can not be world wide. Let us plan our own house lot to secure the optimum use of the land available but with our eyes on the need for a treatment harmonious with our neighbor's land and with the knowledge that what we as individuals may do will have its influence on the lives of our fellow creatures even if they but pass by. It is difficult, for example, to gladden the heart of a fellow creature by displaying to his gaze our private cemetery of disembowelled but uninterred automobiles. Similarly, let us plan our town or our county with a view to the optimum use of all the land for the benefit of all, but bearing in mind the needs of the state as a whole and allowing by an elastic plan for

changes in the habits of mankind. Finally let us plan nationally so as to secure the best of our country, but not forgetting the world as a whole.

Wordsworth has truthfully said,

> . . . To the solid ground
> Of Nature trusts the mind that builds for aye,

and in planning the land for the future we must not neglect the steady solid work of inquiry which can not be done in a day or a decade and for the pursuit of which our universities and colleges need every encouragement. Then let us be reminded by the doggerel of at least one of the world's great troubles of the present day:

> The World is a bundle of hay,
> Mankind are the asses who pull
> But each tugs in a different way. . . .

If we plan efficiently and pull together there is plenty of hay for all.

ELEMENT 91

By Professor ARISTID V. GROSSE
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THE announcement at the recent meeting of the American Chemical Society in Cleveland of the isolation of 0.1 grams of protactinium oxide and the preparation of metallic element 91 has aroused quite a wide interest in this new element, and it is with pleasure that I follow the suggestion of SCIENCE to write an article on this subject.

(1) INTRODUCTION

The existence of an element between thorium and uranium was predicted in 1869, with the genesis of the greatest generalization of chemistry in the last century—the periodic system of the elements of D. Mendeléeff, whose centenary of birth is now being celebrated.

This element—*ekatantalum* in Mendeléeff's nomenclature, or *Element 91,* according to its number in his system—is now represented by three natural radioactive atomic species or isotopes, to which very recently one, or perhaps two, artificial radioactive species have been added (see Table I).

Chemically, all these species are indistinguishable and behave absolutely alike, so that the chemical properties of Element 91 can be inferred from any one of them; their radioactive or nuclear properties, however, are widely different.

The first representative of Element 91 was discovered in 1913 by K. Fajans and O. Göhring in the form of the rapidly decaying *brevium,* with an average life of its atom = 100 sec. All other isotopes of ekatantalum have also a very short life and are characterized by the emission of negative electrons, with the exception of protactinium which emits -particles, and which is the most important because of its long life.

It was in 1917 that Frederick Soddy, the distinguished pioneer in radioactivity, in collaboration with J. A. Cranston in England and simultaneously and independently O. Hahn and L. Meitner, the leading radiologists in Germany, obtained preparations which gradually transformed into actinium and discovered new alpha rays, which could be due only to a new isotope of Element 91, subsequently named protactinium, present in great dilution in their material.

During the following 10 years all efforts to obtain and isolate the very rare protactinium were unsuccessful, owing to wrong chemical properties being attributed to it, and until 1927 nobody actually saw it or any of its pure compounds. It was generally thought that Element 91 resembles tantalum, just as radium resembles barium; since the latter are always associated in analytical operations, attempts were made to isolate protactinium by adding tantalum to the raw material and extracting them together.

We have to expect, however, for Element 91, according to the periodic law, besides properties similar to tantalum and columbium, also other *individual* and *characteristic* properties, *differing* from its analogues, which should simplify the isolation of the element. Basing himself on these considerations, the writer had the good fortune of extracting in 1927 in pure form the first two milligrams of the pentoxide of protactinium—Pa_2O_5; we attribute this result solely to the great guiding force of Mendeléeff's principle.[1]

In 1928 a technical process of extraction was worked out, and thanks to the help of the I. G. Farbenindustrie A. G. about one half a ton of radium residues could be worked up at their factory in Ludwigshafen on the Rhine and about 40 milligrams of Pa_2O_5 were obtained. From then on our efforts were concentrated on the production of larger quantities of the element for the study of its properties.

(2) CHEMICAL PROPERTIES OF EKATANTALUM AND ITS COMPOUNDS

Mr. M. Agruss and the writer[2] have recently obtained over 0.1 gram of protactinium oxide (see sec-

[1] A. V. Grosse, *Nature,* 120: 621, 1927; *Naturwissenschaften,* 15: 766, 1927.

[2] A. V. Grosse and M. S. Agruss, *Jour. Am. Chem. Soc.,* 56: 2200, 1934.

tion 6), which allowed the preparation of new compounds and the metal itself. The following is a brief résumé of the compounds known.

Metallic ekatantalum (Et) is a silvery gray shiny metal. In contrast to radium it does not tarnish or oxidize in air. It can be prepared by vacuum cracking of its halides on a tungsten filament at high temperatures, according to the equation:

$$2\,EtX_5 \rightarrow 2\,Et + 5\,X_2 \uparrow (X = \text{Halogen})$$

or by electron bombardment of the oxide.

Ekatantalum pentoxide—Et_2O_5—is a perfectly white powder, with a high melting point. It is a weak base and forms salts with acids. It is easily soluble in 10 per cent. hydrofluoric acid; on evaporating this solution *ekatantalum fluoride hydrate* is obtained in colorless crystals. It forms with potassium fluoride the double salt, *potassium ekatantalum fluoride* K_2EtF_7, which crystallizes in long beautiful needles.

The pentachloride—$EtCl_5$—sublimes also in long, colorless, shiny, needle-like crystals, melting at 301° C. It can be easily obtained according to the equation:

$$Et_2O_5 + 5\,COCl_2 \rightarrow 2\,EtCl_5 + 5\,CO_2$$

at 550° C; at the same time small amounts of an oxychloride with a much higher melting point ($EtOCl_3$?) are also formed.

The pentachloride is hydrolyzed by water into hydrogen chloride and the oxide hydrate. It can be converted into the *bromide* or *iodide* by heating with the corresponding hydrogen halide or alkali halides.

The most characteristic analytical reaction of Element 91 consists in its coprecipitation with zirconium or hafnium phosphate from highly acid solutions.

The atomic weight of *protactinium* was found to be 231 ± 0.5 by converting K_2PaF_7 into Pa_2O_5. The ratio of the masses of $K_2PaF_7 : Pa_2O_5$ was found to be 1.6332 and 1.6323.[3]

(3) The Radioactive Properties of the Isotopes of Element 91

The general radioactive properties of all known isotopes are correlated in Table 1.

TABLE 1
Isotopes of Element 91

	Name of isotope	Symbol	Atomic weight	Average life	Half-period	Nature of rays	Remarks
	Natural isotopes						
1	Brevium or Uranium X_2	Bv UX_2	234	1.65 min.	1.14 min.	β	Discovered by Fajans in 1913
2	Protactinium	Pa	231	46000 years	32000 years	α(β+γ)	
3	Uranium Z	UZ	234	9.7 hours	6.7 hours	β	Discovered by Hahn in 1921
	Artificial isotopes						
1	Radio-brevium I*	RmI	238? 235?	19 min.	13 min.	β	Considered to be element 93 by Fermi & coworkers
2	Radio-brevium II	RmII	238? 235?	130–145 min.	90–100 min.	β	Considered to be element 93 by Fermi & coworkers

* See A. V. Grosse and M. S. Agruss, *Phys. Rev.*, 46: 241, 1934.

It is immediately seen that protactinium occupies an exceptional position, as it is the only one with a sufficiently long life which enables it to be isolated. Like radium it emits nuclei of helium atoms or α-particles, negative electrons or β-particles and γ-rays. Like radium it disintegrates through a whole number of radioactive elements, the so-called actinium series, into the final stable product—actinium lead (see Table 4).

The properties of the rays of protactinium and radium proper are compared in Table 2.

TABLE 2
Comparison of the Physical Properties of Protactinium and Radium

Properties	Protactinium	Radium
Average life of atom in years	46,000	2,500
Half-period in years	32,000	1,600
Alpha rays:		
Range in centimeters in air at 760 mm and at 15° C.	3.673	3.389
Velocity in kilometers per second	15,500	15,100
Energy in volts	2,540,000	2,365,000
Beta rays:		
Maximum energy in volts	318,200	185,000
Gamma rays:		
Wave length of the most penetrating ray in 10^{-11} cm	38.2	66.0
Maximum energy in volts	323,000	187,000

[3] A. V. Grosse, *Jour. Am. Chem. Soc.*, 56, 2501, 1934.

In this connection it should be stressed, however, that the present use of radium in medicine is chiefly due to the γ-rays of its disintegration products (RaB and RaC, C′, C″ from radium emanation), which have a much greater penetrating power than either protactinium or radium proper. Besides, the accumulation of disintegration products in protactinium or radium takes place with widely different rates; radium reaches equilibrium with its products or its maximum activity in about 25 days, whereas for protactinium half of the maximum is reached only in about 15 years.

(4) Occurrence in Nature and Origin

Protactinium occurs in nature always together with radium. It was originally thought that protactinium is much rarer than radium, but recent investigations show that for every 10 grams of radium 8 grams of protactinium are found, no matter what the ore or mineral is.

Since both these radio elements have a very short life compared to the age of our earth, they would have died out long ago had it not been for the fact that they are continuously being formed from the element uranium, although from two different isotopes. The isotope from which protactinium originates is called actino-uranium (symbol = AcU); it has an average life of 650 million years.

For the reasons given above protactinium and radium are found in every mineral or rock containing uranium and in quantities proportional to the uranium content. In the following table analyses of different uranium minerals are given.

TABLE 3

Protactinium and Radium Content of Minerals
(1 metric ton = 1.000.000.000 milligrams)

	Name of mineral	Location	Uranium content in per cent.	Radium content in milligrams per met. ton	Protactinium content in milligrams per met. ton
1	Carnotite	Colorado, U. S. A.	19.09	64.0	52.0
2	Pitchblende	Wilberforce, Canada	52.71	178.0	144.0
3	Kolm	Gullhogen, Sweden	0.41	1.4	1.1
4	Pitchblende	Katanga, Africa	72.26	244.0	198.0
5	Pitchblende	Morogoro, East Africa	70.45	237.0	192.0

(5) The Disintegration Products of Protactinium

The products of protactinium disintegration, their average and half lives, the nature of rays emitted and their chemical properties are given in Table 4.

Actinium or Element 89 is the first disintegration product of protactinium and was discovered by A. Debierne very shortly after the discovery of radium by the Curies. It has never been obtained in a greater concentration than about 1 part in 100,000 and Madame M. Curie devoted much of her time to this element in the last years of her life, because of its interest to medicine. The α-activity of actinium, in equilibrium with all its disintegration products, is about 140 times greater than that of the same quantity of radium.

Now that pure protactinium is available the isolation of actinium is just a question of time; one has only to let a protactinium preparation stand for a year or two and then separate the accumulated actinium.

(6) Technical Extraction

Thanks to the energy and skill of Mr. M. S. Agruss and based on the experience obtained in the extraction of the first 40 mg of protactinium (see introduction), a technical process for protactinium production was installed and made to operate on a semi-commercial scale. Through the courtesy of the Lindsay Light Company and with the assistance of Dr. Mark Eichelberger the facilities of their plant in West Chicago was made available for this purpose.

The best starting material is the so-called "residue of residues" (containing on the average 60 per cent. SiO_2, 20 per cent. Fe_2O_3, 7 per cent. PbO and smaller amounts of many other elements), discarded from the process of radium extraction and of no commercial value at present; it contains about 0.30 grams Pa per metric ton. About 5 tons of these residues were bought at a reduced price and exchanged for patent rights from the Czechoslovakian Government, which owns the oldest radium factory in the world at Joa-

chimsthal, Bohemia. The negotiations carried on for this purpose were successful largely due to the efficient support of Mr. A. C. Ratchesky, U. S. Minister to Czechoslovakia, and Mr. Frank Novotny, of the U. S. Legation in Prague.

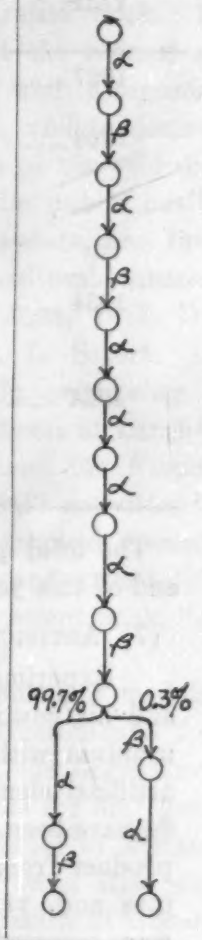
The process involves the use of only two main chemicals, muriatic acid and flake caustic soda. The principle of the process can best be seen from Fig.

The plant product, containing an average of 1 p

TABLE 4

THE ACTINIUM RADIO-ACTIVE SERIES

Radio-element and symbol	Atomic number	Isotopic with	Atomic weight	Type of disintegration	Half-period	Scheme of distintegration
Actino-uranium, AcU	92	U	235	Alpha	$4.0 \cdot 10^8$ yrs.	
Uranium Y, UY	90	Th	231	Beta	24.6 hours	
Protactinoum, Pa	91	Et	231	Alpha	32,000 years	
Actinium Ac	89	Ac	227	Beta	13.4 years	
Radio-actinium, Ra-Ac	90	Th	227	Alpha	18.9 days	
Actinium X, AcX	88	Ra	223	Alpha	11.2 days	
Actinon or Actinium Emanation, Ac-Em	86	Em	219	Alpha	3.92 seconds	
Actinium A, AcA	84	Po	215	Alpha	0.002 seconds	
Actinium B, AcB	82	Pb	211	Beta	36.0 minutes	
Actinium C, AcC	83	Bi	211	Alpha and Beta	2.16 minutes	
Actinium C′ AcC′	84	Po	211	Alpha	ca. 0.005 sec.	
Actinium C″, AcC″	81	Tl	207	Beta	4.76 minutes	
Actinium Lead or Actinium D AcD	82	Pb	207	.....	Stable	



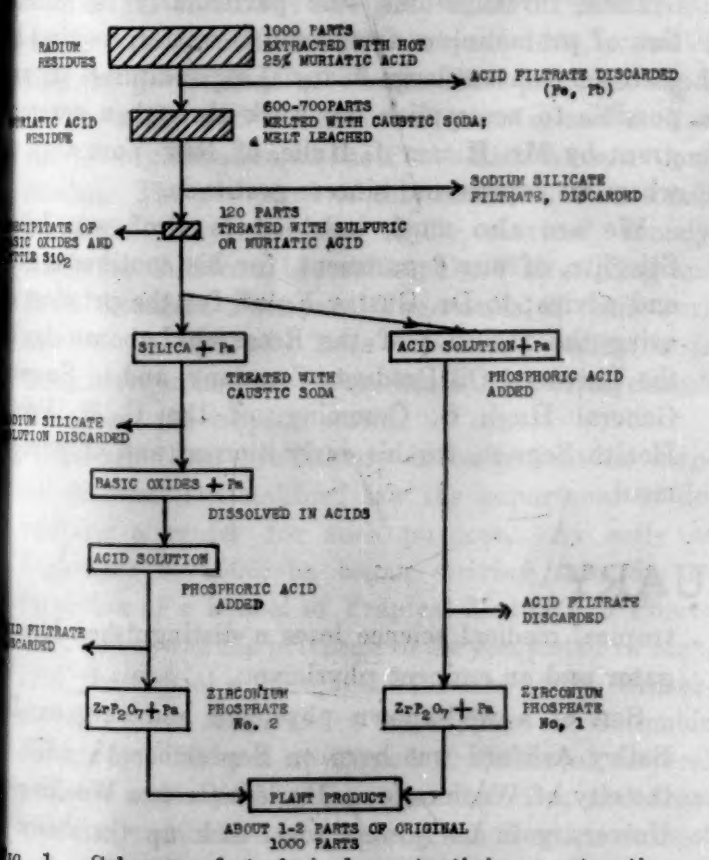


FIG. 1. Scheme of technical protactinium extraction process.

in 5,000 of protactinium, is further concentrated in the laboratory by means of the spiral process, as illustrated in Fig. 2.

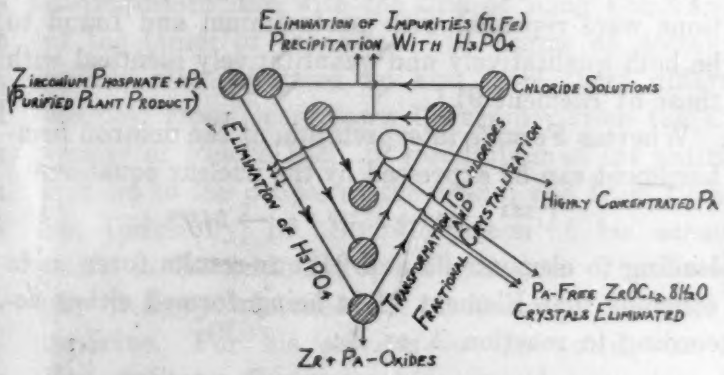


FIG. 2. Spiral concentration process.

In this way preparations containing 10 per cent. protactinium are obtained, from which the pure compounds of the element can be easily isolated.

Up to the present moment about 0.20 grams protactinium oxide were obtained either in the pure or highly concentrated state.

Recently our technical and laboratory process has been successfully used in Germany by Drs. G. Graue and H. Käding[4] and about 0.70 grams of protactinium

isolated from about 5 tons of radium residues. The figures for the present "world production" are correlated in Table 5.

TABLE 5

Year	Amount of Pa in milligrams	Remarks
1927	2	
1928	40	At the I.G. Farbenindustrie A.G., in Ludwigshafen on the Rhine.
1934	700	by G. Graue and H. Käding.
1934	200	at Lindsay Light Co., in West Chicago, Ill.

The total quantity of protactinium available at the end of this year will be over 1 gram.

(7) ARTIFICIAL ISOTOPES. (FERMI'S ELEMENT 93)

Experiments carried out this year by E. Fermi and his coworkers[5] in Italy on the bombardment of uranium with neutrons have led him to believe that artificial elements with an atomic number of 93 and 94 have been formed. Particularly the β-ray emitting product from uranium with a half period of 13 minutes and, very recently, the 90–100 minute element were assumed to be isotopes of element 93 because of the similarity of their reactions with manganese[5] and rhenium (element 75)[6] and their dissimilarity from the heaviest elements.

In collaboration with Mr. M. S. Agruss these reactions were repeated with protactinium and found to be both qualitatively and quantitatively identical with those of Element 91.[7]

Whereas Fermi's interpretation of the neutron bombardment can be expressed by the nuclear equation:

$$U_{92}^{238} + {}_0n^1 \rightarrow 93^{239} + \varepsilon^- \rightarrow 94^{239}$$

leading to elements 93 and 94, our results force us to conclude that Element 91 is being formed either according to reaction A or B:

$$_{92}U^{238} + {}_0n^1 \rightarrow {}_{91}Et^{238} + {}_1H^1; \quad {}_{91}Et^{238} \xrightarrow{\beta} {}_{92}U^{238} \quad \text{A}$$

$$_{92}U^{238} + {}_0n^1 \rightarrow {}_{90}Th^{235} + {}_2He^4;$$

$$_{90}Th^{235} \xrightarrow{\beta} {}_{91}Et^{235} \xrightarrow{\beta} {}_{92}U^{235} \quad \text{B}$$

If these interpretations are correct they point a way to the synthetic production of the fourth and as yet unknown radioactive series, with atomic weights $=4n+1$ (n being any whole number), by neutron bombardment of members of the thorium series, as exemplified by the equation:

$$_{90}Th^{232} + {}_0n^1 \rightarrow 88^{229} + {}_2He^4; \quad 88^{229} \xrightarrow{\alpha \text{ or } \beta} \text{fourth series.}$$

(8) FUTURE PRACTICAL APPLICATION

What are the practical uses of Element 91?

It is yet premature to answer this question. Because of its chemical properties, dissimilar to radium, protactinium might find an application in radiology and medicine, different from radium; also constant formation of actinium might be of large practical value. Perhaps the stability in air of the metal or the possibility of plating other metals with it (radio tubes?) will be found useful. We are confident that it will find an application in the future like most of the rare elements; as an example we may remember the case of neon. Twenty-five years ago it was one of the rarest gases in the atmosphere; now its light illuminates the skies.

(9) ACKNOWLEDGMENTS

These investigations, and particularly the extraction of protactinium from radium wastes, required by their very nature large financial expenditures. It was possible to accomplish the work through a generous grant by Mr. Hiram J. Halle, of New York City, to whom we express our sincere gratitude.

We are also much indebted to Professor Julius Stieglitz, of our department, for his continuous help and advice; to Dr. Gustav Egloff for the privilege of using the facilities of the Research Laboratories of the Universal Oil Products Company, and to Surgeon General Hugh S. Cumming, of the U. S. Public Health Service, for his early interest and encouragement.

[4] G. Graue and H. Käding, *Naturwissenschaften*, 22: 386, 1934.

[5] See E. Fermi, *Nature*, 133: 898, 1934.

[6] E. Fermi, E. Amaldi, O. D'Agostino, F. Rasetti and E. Segré, *Proc. Roy. Soc.*, A. 146: 495, 1934.

[7] A. V. Grosse and M. S. Agruss, *Phys. Rev.*, 46: 241, 1934; results with rhenium yet unpublished.

OBITUARY

BAILEY KELLY ASHFORD

IN the death of Dr. Bailey Kelly Ashford at his home in San Juan, Puerto Rico, on November 1, 1934, tropical medical science loses a distinguished investigator and an eminent physician.

Son of a well-known physician and surgeon, Dr. Bailey Ashford was born on September 18, 1873, in the city of Washington. He left George Washington University in his junior year, took up the study of medicine in the Georgetown Medical School and graduated therefrom in the year 1896. The following two

years he dedicated to specializing in the Army Medical School and was commissioned from it as assistant brigadier surgeon of the expedition of 1898 to Puerto Rico. Shortly after his arrival he made his first important contribution to science and to mankind.

On November 24, 1899, he announced that he had found "the cause of many pernicious, progressive anemias of the Island to be due to *Ankylostomum duodenale*." Soon after this discovery Dr. Ashford was instructed by the chief surgeon to aid the Superior Board of Health in preparing a pamphlet on anemia, its causes, treatment and prevention, which appeared in 1900. Following this publication, others have appeared on the subject of uncinariasis, many of which are to-day regarded as the most complete and accurate expositions of the hookworm problem extant.

In December of 1897 he returned to Washington, carrying with him the worms he had obtained from several of his anemic patients. These parasites he left in the hands of Dr. Albert Hassall, who, recognizing the possibility of their being a new species, recommended a more detailed study of them. His supposition proved correct, and later they were named by Dr. Stiles *Necator americanus*.

Realizing the importance of this discovery and the significance of a disease which accounted for over thirty per cent. of the total high mortality at that time, Dr. Ashford expressed his earnest desire to return to the island in order to do further research. His request was granted, but the importance of his work in the treatment and prevention of uncinariasis was not fully realized until the year 1904, at which time the government of Puerto Rico provided funds for the study and treatment of anemia, and authorized the organization of the Porto Rico Anemia Commission. The personnel of this commission was made up of the early associates of Dr. Ashford, namely, Dr. Pedro Gutiérrez Igaravídez, Dr. Walter King and Dr. I. González Martínez. The results of their work are well known and have stimulated endeavor in various organizations to eradicate hookworm disease throughout the tropical world.

Through these preliminary investigations on tropical diseases, Dr. Ashford saw the importance of developing a center for such purpose. As early as September 5, 1906, he began striving towards the formation of a School of Tropical Medicine in Puerto Rico, and it was his privilege to see completed in May, 1926, the School of Tropical Medicine of the University of Puerto Rico, under the auspices of Columbia University. He was appointed professor of tropical medicine and mycology in this institution, and from that time, until the acute stage of his illness, was most actively engaged in investigating tropical anemias, sprue, filariasis and such like conditions, and at the same time devoted himself to the needs of a large number of patients.

Dr. Ashford's work was not confined only to the Island of Puerto Rico. Soon after the cyclone of 1908, he was commissioned to the state of Mississippi, where he was placed in charge of relief work. In January, 1916, he visited Brazil, at the request of the Rockefeller Foundation, to study and to organize a campaign against tropical diseases, and to demonstrate to the Brazilian the advantages of the field dispensary as a means of extending the public health program far into the interior of the state, and thus get in closer touch with the agricultural laborer. Then came the world war, and in June, 1917, Dr. Ashford enlisted under General W. L. Sibert. In France he was exceedingly active in organizing a school for the training of American officers at Langres and in inspecting dressing stations and the French and British hospitals. Colonel Ashford's activities in the world war, his hostilities against tropical diseases and other incidents of his energetic and varied life are interestingly and well told in his recent book, "A Soldier in Science."

Dr. Ashford received many citations and medals. As a tribute to his rapid rise to distinction and for his incalculable services to the island, the Legislature of Puerto Rico voted him special thanks for his "commendable accomplishments as a benefactor to humanity." The Medical Association of Puerto Rico enrolled him as an honorary member; President Gómez of Venezuela decorated him with the Medal of Public Instruction for his valuable work in the interest of the education of the people of Venezuela. For his services in the field of medicine, the King of Egypt distinguished him with the title of King Commander of the Order of the Nile. The degree of doctor of science was conferred on him from three different sources; from Georgetown University, from the University of Puerto Rico, in recognition of his untiring services to the people of the island, and from Columbia University, in acknowledgment of his achievements in the field of tropical medicine. The University of Egypt accorded him the honorary doctorate of medicine. For his services in the world war the United States Government conferred upon him the Victory Medal; for his activities with the British Government, he was created Companion of the Order of St. Michael and St. George. In December, 1933, the Government of Puerto Rico symbolized the affection of its people for him by presenting them with a bronze bust of Dr. Ashford, which has been placed in the School of Tropical Medicine, the center point of his labors and unselfish service to others. In his speech of acceptance of this gift, which conveys the admiration which the people of Puerto Rico had for

Dr. Ashford, the director of the School of Tropical Medicine said, in part:

> To our immediate Association it will be a silent and ever-present inspiration of courage and victory in the face of overwhelming odds; to the People of Puerto Rico who have made possible this noble gift, it is a visual recognition of the affection felt by rich and by poor alike for one who has given his services freely and impartially. Not only do they regard him as a healer, but as an instructor who has indicated the way to health to thousands of living in hookworm-infested areas. To future generations it will be pointed to with pride, as a symbolized standard of high achievement by which to measure their own attainments.

Dr. Ashford is survived by his wife and three married children, all at present in Puerto Rico. He was buried on November the second, according to the rites of the Episcopal Church, and with full military honors, in the military cemetery of San Juan. Affection and respect were shown by thousands of people, who from all walks of life followed their beloved soldier and scientist to the grave.

GEORGE W. BACHMAN

PHILIPP FISCHELIS

DR. PHILIPP FISCHELIS died at his home in Philadelphia of angina pectoris on Tuesday, October 30, 1934, at the age of 76. He was buried the following Friday at Chelten Hills Cemetery in Philadelphia.

Although not in the best of health for some months he had continued his teaching in the School of Dentistry of Temple University and had lectured to his classes on the afternoon preceding his demise. He returned to his home from a faculty meeting late on Monday, October 29, and passed away shortly after midnight.

Dr. Fischelis was born on December 8, 1857. He studied biology and medicine at various universities in Europe, including Leipzig, Koenigsberg and Berlin. He received the degree of doctor of medicine from the University of Berlin in 1885 and after further study and interneship at hospitals in Berlin he came to the United States in 1889, settling in Philadelphia, where he practised medicine for many years and taught histology, embryology and pathology at several medical and dental colleges. In 1890 he married Ernestine Kempt, who died in 1923. They had three sons and three daughters, all of whom survive.

Among the teaching positions held by Dr. Fischelis are the following: Instructor in rhinology and laryngology at the Philadelphia Polyclinic (1893–1902); demonstrator of histology and embryology, Medico-Chirurgical College of Philadelphia (1903–1909); associate professor (1909–1917); professor of histology, embryology and general pathology and director of laboratories in the Dental School of Temple University, Philadelphia (1917–1934).

His researches in Germany and in this country included work on the development of the thyroid and thymus glands and lungs. He was author of the chapters on reproduction and evolution in "Ott's Physiology" and co-author with Dr. I. N. Broomell of "Anatomy and Histology of the Mouth and Teeth."

He was a member of the American Medical Association, the Pennsylvania and Philadelphia County Medical Societies, the American Association for the Advancement of Science, the American Association of Anatomists, the Association of American University Professors, the National Geographic Societies and other organizations.

A wide circle of friends, colleagues and former students mourn his loss.

A CORRESPONDENT

MEMORIALS

A PORTRAIT of Dr. Otto Knut Olof Folin, who, at the time of his death, on October 25, was Hamilton Kuhn professor of biological chemistry at Harvard, was presented to the university at memorial exercises held in the Medical School on November 23. Professor Walter B. Cannon presented the portrait, and Dr. David L. Edsall, dean of the Medical School, accepted it in behalf of the university. The other speakers were Professor Cyrus H. Fiske and Professor Henry A. Christian. The portrait was originally to have been given in Dr. Folin's presence at a dinner celebrating his service to the university.

AT the fiftieth anniversary meeting of the Association of Official Agricultural Chemists at Washington, Dr. W. D. Bigelow, director of the research laboratories of the National Canners Association of Washington, delivered the fourth Wiley Memorial Address, his subject being "Food Preservation in Relation to Public Health." Dr. Bigelow was the first assistant chief of the Bureau of Chemistry of the U. S. Department of Agriculture, under Dr. Wiley, the first president of the association.

THE Adolph Lomb Optical Library has been presented to the University of Virginia by Henry C. Lomb, of New York, as a memorial to his brother, Adolph Lomb. Liberal provision has been made for the shelving of this special library and for keeping the material up to date. Included in the collection are 706 books, 470 monographs and brochures and 174 bound and 86 unbound volumes of scientific journals. According to Professor Llewellyn G. Hoxton, head of the school of physics, there are among these many rare volumes that can not be found elsewhere in the United States and in but few European libraries.

FOLLOWING the death of Dr. Walter Ernest Dixon, of Cambridge, England, in August, 1931, a memorial fund was collected to establish a lectureship in therapeutics and pharmacology in his memory. The first Dixon Memorial Lecture will be given by Sir Henry Dale at the Royal Society of Medicine on December 11. The subject of his address will be "Pharmacology and Nerve Endings."

A SQUARE in front of the Salpêtrière, Paris, has recently been named after the late Mme. Marie Curie.

RECENT DEATHS

DR. COLLIER COBB, professor of geology at the University of North Carolina, died on November 28. He was seventy-two years old.

DR. OTTO VERNON DARBISHIRE, Melville Wills professor of botany at the University of Bristol, died on October 11, at the age of sixty-four years.

DR. JOHN WALTER LEATHER, from 1892 to 1916 agricultural chemist to the Government of India, died on November 14. He was seventy-three years old.

SCIENTIFIC EVENTS

THE "MEDICAL CITY" OF THE SOVIET UNION

HAROLD DENNY, correspondent of *The New York Times*, cables that in Moscow the Soviet government has allotted a 1,000-acre site in the Silver Forest on the Moscow River, a ten-minute drive from the capital, for "Medical City," designed to be the largest and most modern medical institute in the world. The plans are being drawn in consultation with a commission that recently studied the Columbia Presbyterian Medical Center, the New York Hospital-Cornell University Medical Center and the Rockefeller Institute in New York. Actual construction of the great network of buildings, which are planned to cost 150,000,000 rubles, is scheduled to begin in the spring.

The organization that will use the new plant is already functioning as the All-Union Institute of Experimental Medicine. It is under the direct authority of the government and its findings are turned over to the Commissariat of Health for application in hospitals throughout the Soviet Union. The director is Professor Lev Nicolaevich Feodorov, pupil of Professor Ivan Pavlov.

The enlarged institution plans to cover both the work done by the Cornell and Columbia Presbyterian centers and the Rockefeller Institute—that is, both practical and theoretical. A feature will be the "Clinic of the Healthy Man," where observations will be made of the behavior of normal men and women after working, eating, resting, etc. There will be special chambers, where the temperature, air pressure and other conditions of different climates—arctic, sub-tropic and even undersea and stratospheric—will be reproduced and their effects on living organisms studied.

The institute will be a real city with a technical personnel of 5,500 doctors, nurses and research workers and 600 patients, each of the latter in a private room, and with almost one laboratory per patient. There will be apartment houses for the staff, and stores, theaters and other features of a complete town.

A NATIONAL INVENTORY OF LAND PRODUCTIVITY

A PLAN to make an inventory of land resources which will give each type of land an index number of value based on productivity was presented before the recent annual meeting of the American Soil Survey Association. The scheme was developed by the Bureau of Chemistry and Soils, U. S. Department of Agriculture, and is being further developed in several states.

The productivity of each land type for a certain crop is being recorded in relation to the productivity of the best land in the country for that crop. The value of this most productive land type would be represented by 100. Land half as productive would be listed at 50. This makes possible the comparison of land types as to productivity, not only within a locality of county, but in widely separated regions.

A classification of land types as to physical productivity is desirable because of the various factors responsible for productivity in general—land, labor, fertilizer, seed, implements and management. All but land are variable as to time. They are variable because of the ease with which they can be modified by man in response to economic conditions. The characteristics of land, climate, surface and soil are essentially stable.

Thus, a geographic inventory of land resources will have significance 50 to 100 years hence and not merely at the present, even though some changes in land do occur through such agents as erosion or irrigation.

In the case of poorly drained land or land subject to overflow, two sets of productivity numbers are given, one applying to the land in its poorly drained or flood-hazardous condition, the other under conditions of the best drainage or protection from overflow. No classification of irrigated land types has yet been undertaken on this basis.

As a summary of these crop ratings, lands are listed as to their general agricultural worth or productivity. Each type receives a general agricultural rating, based primarily on its productivity for the great staple crops, particularly grass and grain crops. The most productive land is designated Grade 1. Land incapable of producing crops, such as rock outcrop or desert, is listed as Grade 10.

A supplementary index of productivity has been added in the case of all land types on which farm practice, mainly through the use of fertilizer, is more intensive than in standard practice. There are said to be some who believe this index to be the more important. It has the disadvantage, however, of becoming invalid with time and it gives no indication of the disadvantage of lands requiring fertilization to produce equivalent yields.

MOTION PICTURES AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE first of a series of animated scientific and engineering motion pictures designed to facilitate methods of teaching has been completed by the new division of visual education at the Massachusetts Institute of Technology. It presents for the first time in visual animated form the behavior of an electrical wave as it travels along a 250-mile transmission line.

Other films in the proposed series include the presentation of descriptive geometry in animated form, the operation of complex machinery, principles of physics, problems of human relations and many others. This method of visual education is expected to be particularly effective in helping students to grasp the meaning of many of the more difficult subjects, which are not easily described by conventional teaching methods. The films, while designed primarily for instruction of students of the institute, are expected to be available to other educational institutions.

The new film "Traveling Waves on Transmission Lines" is a combination of animation and outdoor scenes showing various types of high voltage power lines. What happens when a switch is closed and electricity flows along such lines is graphically presented in the form of a dark wave flowing along a power line. The picture reveals that for a few millionths of a second after a switch is closed the electrical wave flows back and forth on the line and is often accompanied by extra high voltages. The effect is similar to the wave forms produced when water flows into a trough, strikes the end and rolls back and forth, finally reaching a steady level. The same phenomenon occurs on a smaller scale when an ordinary household light is turned on.

The mathematical analysis of the complete effect is so complicated that it has never been worked out, even for the simplest actual conditions. The form and progress of the electrical impulses have, however, been accurately reconstructed in the department of electrical engineering at the institute from precise continuous records made at short intervals along the line which was carrying the impulse. The study was made on a laboratory model of a 250-mile power line in which actual operating conditions could be reproduced. It was carried out by Professor Louis F. Woodruff. The films produced by the new division of visual education are being directed by Frank H. Conant, head of the photographic service, in consultation with Floyd H. Ramsdell, general manager of the Worcester Film Corporation.

PHOTOGRAPHIC TELESCOPE FOR THE LICK OBSERVATORY

A GIFT of $65,000 for the construction of a powerful wide-angle star camera or photographic telescope at Lick Observatory on Mt. Hamilton has been received by the University of California from the Carnegie Corporation of New York. This announcement was made by President Robert Gordon Sproul following the receipt of official notification of the gift from President F. P. Keppel, of the Carnegie Corporation.

Director R. G. Aitken, of the Lick Observatory, states that the instrument which is to be built will be the largest and most powerful of its kind, taking in a sky area of six or more degrees at the equator, and recording all stars down to at least the nineteenth magnitude in a two-hour exposure.

Stars of the nineteenth magnitude are about 150,000 times as faint as any that can be seen with the naked eye. An instrument capable of recording them will, according to the most reliable estimates, allow astronomers to study almost 300,000,000 stars in the stellar system immediately surrounding the earth.

Dr. Aitken adds that this gift, aside from being the largest received by Lick Observatory since its founding more than fifty years ago, will provide an instrument which in many ways will be the most powerful at Mt. Hamilton. It will enable astronomers stationed there to extend their investigations of the stars in several directions.

Particularly it will make possible a study of the structure and dynamics of the stellar galaxy, including the question of its rotation. This study will be carried on by Astronomer W. H. Wright, who submitted designs for the instrument with this purpose in view. It is hoped that the telescope will be completed and ready for use before the end of 1936.

Lick Observatory opened its doors in 1888, although the money for its construction was made available, and the search for a desirable site began fourteen years

before. The funds consisted of a deed of trust for $700,000, left in 1847 by James Lick.

GRANTS FOR RESEARCH OF THE VIRGINIA ACADEMY OF SCIENCE

AT the recent meeting of the Research Committee of the Virginia Academy of Science, the following grants were made in aid of scientific research in Virginia:

To Dr. J. W. Beams, of the University of Virginia, $150.00 for the study of the initiation of lightning discharges. He plans to photograph lightning discharges with a special camera which will make a million or more exposures each second.

To W. B. Bell, of the Virginia Polytechnic Institute, $28.50 to enable him to purchase a LaMotte blood pH outfit with which to study the reaction of the blood of normal and leukotic fowls. This work will be done in connection with Dr. E. P. Johnson, who won the academy prize last year for his work on the leukosis of fowls.

To Dr. Walter S. Flory, of Bridgewater College, $70.00 with which to purchase an oil-immersion objective and other accessories for the microscope needed in his study of the genetic cytology of the genus gilia of the phlox family. This is part of an extensive study of the character and significance of the chromosomes of various plants which is in progress at the Blandy Experimental Farm of the University of Virginia under the direction of Dr. O. E. White.

To Dr. H. B. Haag, of the Medical College of Virginia, $50.00 with which to purchase pigeons needed in the development of his new method of assaying preparations of digitalis.

To Dr. Carl C. Speidel, of the University of Virginia, $50.00 with which to purchase supplies for photomicrographic work in his study of living cells.

To Dr. Edward Steidtmann, of the Virginia Military Institute, $100.00 with which to purchase an electric hydrogen-ion apparatus for use in his study of the relation of hydrogen-ion concentration of the water to the formation of travertine deposits in the streams near Lexington, Va.

The money thus appropriated is the income from a trust fund which was raised for the academy a few years ago by Dr. J. Shelton Horsley when he was president. The purpose of the trust fund is to encourage and develop scientific research in Virginia.

Besides these grants made directly to research workers, the Research Committee, which administers the fund, also awards a prize of $50 each year at the annual meeting of the academy for an especially meritorious paper presented at that meeting.

These grants are made only to members of the Virginia Academy of Science, but the Research Committee is greatly interested also in the development and encouragement of scientific research in Virginia outside of its own membership and invites persons who have problems on which they need advice or assistance of any kind to communicate with any member of the committee or with the secretary of the academy.

The members of the Research Committee and their fields of interest are: Dr. William G. Guy, of the College of William and Mary, chemistry; Dr. J. Shelton Horsley, of St. Elizabeth's Hospital, Richmond (chairman), medicine; Dean Earle B. Norris, of the Virginia Polytechnic Institute, engineering; Dr. T. McN. Simpson, Jr., of Randolph-Macon College, mathematics, and Dr. O. E. White, of the University of Virginia, biology.

E. C. L. MILLER,
Secretary

GRANTS FOR RESEARCH OF THE GEOLOGICAL SOCIETY OF AMERICA

THE council of the Geological Society of America, meeting in New York in October, approved the following grants in aid of geologic research:

A grant of $3,000 to L. B. Slichter, for assistance and field expenses in connection with an investigation of the elastic properties of the upper crust of the earth.

A grant of $800 to John P. Buwalda, to cover field expenses in connection with geophysical investigation by seismic methods of the depth of fill in the Yosemite Valley.

A grant of $150 to Adolph E. Sandberg, to cover field expenses in study of the Keweenawan lavas of the north shore of Lake Superior.

A grant of $800 to Margaret Fuller Boos, to cover transportation, field and laboratory expenses in study of the youngest pre-Cambrian batholiths in the Front Range, Colorado.

A grant of $230 to P. S. Warren, for field expenses in connection with study of the Mississippian rocks of the Rocky Mountains of Canada, particularly near Crow's Nest Pass, Nordegg and Jasper.

A grant of $450 to F. Fitz Osborne, for field and laboratory expenses covering investigation of sills intruding the Lower Grenville near Shawinigan Falls, Quebec.

A grant of $250 to C. E. Resser, to cover field expenses in study of the Cambrian in the southern Appalachians.

A grant of $350 to Adolph Knopf, to cover the cost of chemical analyses of rocks from the Spanish Peaks, Colorado, in connection with study of the igneous geology of the region.

The council also made the following additional allowances in connection with researches which had received prior support from the society:

An additional grant of $500 to Paul MacClintock and Horace G. Richards, for completion of study of correlation of the marine deposits of Pleistocene age with those of known glacial origin, along the Central Atlantic Seaboard.

An additional grant of $300 to Philip B. King, to cover cost of fossil collecting in connection with studies on the Permian rocks of the Trans-Pecos, Texas.

This recent action brings the total number of grants made by the Geological Society to 100, and the total sum to $103,078.35. These grants are made possible through the bequest of the late Dr. R. A. F. Penrose, Jr., who left approximately four million dollars to the society as an endowment. Full information concerning grants has been distributed to members of the society in Information Circular No. 12, copies of which may be had by others on request.

SCIENTIFIC NOTES AND NEWS

THE Penrose Medal of the Geological Society of America has been awarded to Dr. Charles Schuchert, emeritus professor of invertebrate paleontology at Yale University. The medal, which was established in 1926 by the late Dr. R. A. F. Penrose, Jr., is given for distinguished service and fundamental contribution to the advancement of geologic science. It will be presented to Dr. Schuchert at Rochester, N. Y., on the occasion of the annual dinner of the society on December 28.

A PORTRAIT of Dr. Hugh D. Reed, since 1906 professor of vertebrate zoology at Cornell University, was presented to the university on November 17 by his graduate students and colleagues in the department. It was formally presented by Dr. Julian D. Corrington, of Rochester, who was one of Dr. Reed's students, and officially accepted for the university by President Farrand. Professor Simon H. Gage described the early history and development of the department of zoology and the methods of teaching that were used before 1900, when Dr. Reed joined it as assistant. Professor Benjamin F. Kingsbury told of their acquaintance and of Dr. Reed's work as a student, graduate and member of the faculty of the university. The presentation was followed by an informal reception.

DR. HARRY M. SELDIN, who recently won the International Anesthesia Research Society's silver trophy shield, was the guest of honor on November 7 at a dinner given in New York City by friends and colleagues. The speakers were: Dr. A. T. Newman, dean of the New York University Dental School; Dr. F. R. Brophy, president of the First District Dental Society; Dr. C. Raymond Wells, president of the Second District Dental Society; Dr. Alfred Walker, chairman of the judicial council of the American Dental Association, and Dr. John T. Hanks, FERA dental adviser.

THE *Journal* of the American Medical Association reports that Dr. Elizabeth A. Woodworth, bacteriologist of the Minneapolis health department since 1913, was honorably retired on her seventieth birthday. She had been connected with the department since 1901. Associates presented her with a wrist watch. The Hennepin County Medical Society also honored Dr. Woodworth with a gift of a silver bowl bearing the following inscription: "Dr. Elizabeth A. Woodworth, for thirty-three years of unusual service to humanity." Dr. Woodworth is a graduate of the Minneapolis College of Physicians and Surgeons.

DR. FRANK A. WAUGH, head of the department of landscape architecture at the Massachusetts State College, has been elected an honorary member of the New England Park Association in recognition of his accomplishments in furthering the aims of the association.

THEIR eightieth birthday has been celebrated by the following scientific men: Dr. William Temple Hornaday, director of the New York Zoological Park from 1896 until his retirement as emeritus in 1926; Dr. Edward B. Gleason, professor of otology at the Graduate School of Medicine of the University of Pennsylvania, and Dr. Edward Bausch, president of the Bausch and Lomb Optical Company, responsible for the invention and construction of optical apparatus.

PROFESSOR IRA EUGENE CUTLER, chairman of the division of biological sciences and professor of zoology at the University of Denver, has been made professor emeritus. Professor Cutler has been connected with the university for thirty-six years, first as professor of both botany and zoology, and later of zoology. He is succeeded as chairman of the division by Humphrey Gray Owen, associate professor of zoology.

ACCORDING to the London *Times*, a chair of national health was inaugurated on November 1 at Munich by Dr. Gerhart Wagner, the head of the German Medical Association, who stated that the new chair would form the model for others. The first professor of the new faculty is Dr. Schultze, the Bavarian State Commissar for Health.

DR. THOMAS J. COLLIER, of Atlanta, Ga., was elected president of the Associated Anesthetists of the United States and Canada at its recent Boston meeting.

SIR JOHN CADMAN has been elected president of the British Institution of Petroleum Technologists for the session 1935–36.

SIR HARRY MCGOWAN was installed as president of the British Institute of Fuel at a meeting on Novem-

ber 12. The title of his presidential address was "An Appreciation of the Value of Research to the Fuel Industries."

DR. PHILIP J. DARLINGTON, JR., assistant curator of insects at the Museum of Comparative Zoology, Harvard University, has reported to the museum that he climbed this fall to the summit of Mount La Hotte, 8,000 feet high, the least known and most difficult peak in Haiti.

DR. OLIVER R. MCCOY, assistant professor of anatomy at the University of Rochester, who has been consultant at the Gorgas Memorial Laboratory, has returned from Panama, where he has been engaged for the past three months in the study of filariasis in wild monkeys.

THE assignment of Dr. Paul F. Russell, of the International Health Division of the Rockefeller Foundation, to the All-India Institute of Hygiene, Calcutta, has been cancelled and he will be stationed elsewhere in India, at first in Kasauli, Punjab. Correspondence should, however, be addressed in care of the institute, 21 Central Avenue, Calcutta.

DR. BERNARD MYERS, president of the clinical section of the Royal College of Physicians of London, is visiting the United States. During his visit he planned to lecture at the College of Physicians and Surgeons of Columbia University and at the Medical School of the University of California. He will sail from San Francisco for New Zealand on December 12, where he will represent the British Medical Society at the meeting of its New Zealand branch.

GEORGE J. AZIMOV, professor of animal husbandry of the All-Union Institute of Animal Husbandry, Moscow, U.S.S.R., is planning to visit the United States within the next few months. He proposes to make a study of methods of training and research in animal husbandry.

DR. ROBERT F. LOEB, associate professor of medicine at the College of Physicians and Surgeons of Columbia University, recently conducted a clinic on diabetic acidosis before the faculty and students of the University of California Medical School.

DR. HARVEY CUSHING, Sterling professor of neurology at Yale University and formerly Moseley professor of surgery at the Harvard Medical School, recently gave the foundation lecture on neurosurgery at the dedication ceremonies marking the opening of the Neurological Institute at McGill University.

DR. LOUIS TRENCHARD MORE, dean and fellow of the Graduate School of Arts and Sciences of the University of Cincinnati, addressed the University of Cincinnati Section of Sigma Xi, on November 22, on "The Determination of the Scientific Method by Newton."

DR. HERBERT GROVE DORSEY, principal electrical engineer of the U. S. Coast and Geodetic Survey, gave an illustrated lecture on November 16 on "Modern Hydrographic Surveying" before the Lecture Club of Wells College.

DR. J. B. S. HALDANE, professor of genetics in the University of London, delivered the tenth annual Norman Lockyer lecture of the British Science Guild on November 28. His subject was "Human Biology and Its Applications."

PROFESSOR DEXTER S. KIMBALL, dean of the College of Engineering at Cornell University; Dr. John Johnston, director of research of the U. S. Steel Corporation, and Dr. John H. Finley, associate editor of *The New York Times*, have been appointed to the 1934 lectureships of the American Society of Mechanical Engineers. Dr. Finley delivered the Calvin W. Rice Memorial lecture on December 5. The title of the lecture was "International Friendliness." Dr. Rice was secretary of the society from 1906 until his death.

THE *Journal* of the American Medical Association reports that at the recent meeting of the Washington chapter of the Pan American Medical Association, the speakers were Col. Fielding H. Garrison, Baltimore; Dr. Fred H. Albee, New York, and Dr. Robert Gutierrez, New York. A one minute period of silence opened the meeting in commemoration of the late Dr. Santiago Ramón y Cajal of Madrid.

DR. KARL T. COMPTON, president of the Massachusetts Institute of Technology; Dr. Walter Rautenstrauch, professor of industrial engineering, Columbia University, and Dr. M. L. Crossley, chief chemist of the Calco Chemical Company, will take part on December 14 at 8:30 P. M. in a symposium on "Science in Relation to Social Growth and Economic Development," to be given under the auspices of the American Institute at the American Museum of Natural History.

THE annual meeting of the American Astronomical Society will be held in Philadelphia from December 27 to 29. On the first evening Dr. Walter S. Adams, director of the Mt. Wilson Observatory, will give an address before a joint meeting with the Rittenhouse Astronomical Society at the Franklin Institute. The address will be followed by a reception given by the Rittenhouse Astronomical Society to the national organization. The annual dinner of the American Astronomical Society will take place on December 28 at the Hotel Sylvania.

THE Northwest Scientific Association will hold its annual meeting at the Davenport Hotel in Spokane, Washington, on December 28 and 29, under the presidency of Thomas Large, of Spokane. A special symposium will be held on Friday, December 28, on the migrations of salmon and other fish in the Columbia River and the effect on such migrations of the high Bonneville and Grand Coulee dams. At the annual dinner on Friday night the retiring president, Howard Flint, of the U. S. Forest Experiment Station at Missoula, Montana, will speak on "Scientific Relations in the Life of a Forest." Program meetings during the two days will be held by eight sections as follows: botany-zoology, chemistry-physics-mathematics, education, forestry, geography-geology, engineering, medicine and social science.

ACCORDING to *Nature*, with the object of the promotion of biochemical studies and research, a Biochemical Society has recently been formed at Calcutta. The society was formally inaugurated on July 6, 1934, at the All-India Institute of Hygiene. The first committee of the society is constituted as follows: Professor N. M. Basu, Lieut.-Col. T. C. Boyd, Professor S. Ghosh, Professor J. N. Mukherjee, Dr. B. B. Sen, Professor H. K. Sen, Professor H. E. C. Wilson, with Dr. B. C. Guha as honorary secretary and Dr. B. Ahmad as honorary treasurer. It has been arranged to hold monthly meetings for biochemical discussions and reading of original papers, reviews, etc. Four meetings have already been held.

To commemorate its fiftieth anniversary the Association of Official Agricultural Chemists has issued as No. 4 of its current volume of the *Journal of the Association of Official Agricultural Chemists* a fifty-year index of its publications. This index includes all entries from the Proceedings published in the Department of Agriculture bulletins, the journal of the association, and in the 1920, 1925 and 1930 editions of the "Book of Methods." The association plans to issue a supplementary index each ten years covering subsequent work.

THE Harvard-African Expedition, under the auspices of the department of tropical medicine of Harvard University, has recently returned to this country. This expedition, which left in April, 1934, under the direction of Dr. Richard P. Strong, particularly carried on medical and biological investigations on onchocerciasis, in the regions of the Belgian Congo. Further research on the material brought back from the expedition will be completed in the laboratories of the department by Dr. Strong and Dr. J. H. Sandground. The expedition obtained also some 226 bird skins and some 25 mammal skins, collected and prepared by S. Pierrepont, Jr. A herbarium of some 125 plants was made for the Gray Herbarium by Dr. J. Bequaert, who also collected numerous specimens of miscellaneous insects, mollusks and other invertebrates which will be additions to the collections of the Museum of Comparative Zoology. A collection of photographs was made by Henry Mallinckrodt and Byron L. Bennett.

THE expedition conducted by the Scripps Institution of Oceanography at the University of California in conjunction with the U. S. Hydrographic Office, directed by Dr. Roger R. Revelle, research assistant, aboard the *U. S. S. Bushnell*, the flagship of Admiral C. W. Cole, has collected data to explain the state's "unusual weather" and to aid in forecasting seasonal rainfall and fisheries production. Dr. Revelle was accompanied by fourteen assistants. The expedition started in the extreme of the North Pacific, at the Aleutian Islands, cut across the Japan current, or "western wind drift," and to the tropical waters of Pearl Harbor. Eighteen stations were established, at each of which tests of water composition and temperature were made at various depths from the surface to two miles below sea level.

AN Associated Press dispatch dated November 26 states that in a seven-hour flight Admiral Richard E. Byrd brought back with him conclusive evidence that Marie Byrd Land runs in an unbroken line from the Antarctic coast to the South Pole and that a trans-arctic strait does not exist. It is stated that Admiral Byrd has expressed certainty that there is no water passage east of the 150th meridian, from the 75th parallel to the Pole, a stretch of 1,000 miles.

PLANS for a study of cosmic rays from Mount Tupungato, a 19,680 foot Andean peak on the Argentine frontier, have been announced, according to *The New York Times*, by Director Julio Bustos of El Salto Observatory. The directors of the Bureau of Standards and the Astrophysical Observatory, Washington, are expected to aid the Chilean expedition.

THE regents of the University of Wisconsin, Madison, have appointed a committee to work out plans for using a $450,000 bequest left to the university by Miss Jennie Bowman earlier in this year for the establishment of a cancer institute. Members of the committee are Dr. Glenn Frank, president of the university; Dr. Charles R. Bardeen, dean of the medical school, and Dr. Edwin B. Fred, dean of the graduate school.

LARGE woodlands near Ithaca covering approximately 620 acres have been given to Cornell University by the Lloyd Library and Museum of Cincinnati, Ohio, for the exclusive use of biologists as a natural out-of-door laboratory. They are a memorial to the

indirect donor, C. G. Lloyd, who was the father of John T. Lloyd. For many years a resident of Ithaca, Mr. Lloyd stipulated that when the deeds of the property were turned over to Cornell no trees or undergrowth were to be cut. The woods are to be allowed to follow their natural course of growth, death and decay. They have for years been protected property and now form primeval wildwood.

THE New York Botanical Garden is the recipient of a bequest of ten thousand dollars from the will of Kenneth E. Mackenzie, member of the Board of Managers, who died on October 22. In addition, Mr. Mackenzie bequeathed all his remaining plant specimens and nearly 1,000 drawings which had been made for him by H. C. Creutzberg. A collection of 43,000 plant specimens had been presented to the garden two years ago. Mr. Mackenzie, who was an attorney in New York, had become an authority on the Cyperaceae, or sedges. The legacy of ten thousand dollars, it was stipulated, is for the publication of the illustrations mentioned above.

THE Carnegie Corporation has made a grant to the University of Oregon, sufficient to conduct a thorough search of the region near Bonham Falls in the Deschutes section of Oregon for more evidence of a prehistoric race of men. The work is being carried out by Dr. L. S. Crossman, professor of anthropology at the university.

THE Foundation for the Advancement of Researches on Encephalitis of the University of Berne has offered a prize of one thousand Swiss francs for the best work on the diagnosis and treatment of encephalitis. Competitors should communicate with the dean of the Faculty of Medicine of Berne.

UNDER the will of the widow of Frank Hutchison, formerly the manager of the Canadian Pacific hotel system, the faculty of medicine at McGill University will receive a bequest of about £20,000.

SANTA CRUZ COUNTY has been approved by the Federal Soil Erosion Service as the site for the state's third soil erosion control demonstration project. It will cover an area of 67,000 acres, will carry with it an allotment of $200,000 from the $15,000,000 appropriated by Congress for the purpose of demonstrating methods of erosion control to owners and operators of farm properties, and will be known as the Corralitos Project. The other two project areas in California are near Arroyo Grande, San Luis Obispo County, and in the Los Posas Valley, Ventura County. Sites for the three projects were selected primarily on recommendations made by Walter W. Weir, associate drainage engineer in the Agricultural Experiment Station, University of California, whose studies of erosion were responsible in a large measure for obtaining the appropriation to establish the work in California.

Museum News reports that the Museum of Natural History at Springfield, Mass., of which Mrs. Grace P. Johnson is director, opened its new building to the public on October 13. The structure is of Indiana limestone, two stories and basement, with a ground area 132 by 88 feet. It is adjacent to and connected with the old Natural History building on the northeast corner of the City Library Association quadrangle. The main entrance is on the west, from the interior of the quadrangle. The three floors provide 18,343 square feet of exhibition space and 4,900 square feet for storage. In the basement are a large gallery for Indian material, two classrooms, a transformer room and a workshop. On the ground floor, the main entrance hall, 68 by 18 feet, houses habitat groups of bear, beaver, deer and Antarctic birds; a second large hall is devoted to a life-sized Indian group, the Indian basket collection and other related material; the south gallery to mammals, and the north gallery to birds. On the second floor is the aquarium hall with 15 large tanks, a junior room, galleries for geological and botanical exhibits, and the astronomical department including a planetarium. The planetarium room is 38 feet in diameter with a dome 34 feet in diameter and 23 feet high. The projector is of the compound stereopticon type and was constructed by Frank D. Korkoss, of the museum staff. The seating capacity of the room is about 150. The building was designed by Tilton and Githens and erected at a cost of $25,000. Funds were provided from a bequest of the late Stephen E. Seymour.

A CORRESPONDENT of the *Journal* of the American Medical Association writes: "The Gesellschaft Deutscher Naturforscher und Aerzte held its ninety-third meeting from September 16 to 20 in Hanover, well-known as the home of Leibniz. The attendance of some four thousand found a wide range of topics awaiting their consideration, for thirty allied societies also took part in the proceedings. Among these may be mentioned the Deutsche Chemische Gesellschaft, which contributed half a dozen papers, including one from Professor The Svedberg on the applications of the ultra-centrifuge, and the Kolloid-Gesellschaft, which for its tenth general meeting devoted two very full days to 'Röntgenoskopie und Elektronoskopie von dispersen Systemen, Fäden, Filmen und Grenzschichten.' In addition to the more specialized discussions within the two main divisions of natural science and medicine, there were combined discussions and discourses of wider appeal addressed to the meeting as a whole, after the manner of the British Association. Among the last-mentioned, particular interest

was aroused by Professor W. Heisenberg's lecture, 'Wandlungen der Grundlagen der exakten Naturwissenschaften in jüngster Zeit,' in much the same field as that covered by Sir James Jeans's address at Aberdeen. An exhibition of apparatus, preparations and scientific books was held in the Ausstellungshalle, one of scientific films in the Tierärztliche Hochschule, and another, the traveling exhibition of the Dresden Museum of Hygiene, 'Leben und Gesundheit,' in the Künstlerhaus, while lighter moments were provided for by the Opera House and theater and the usual excursions to neighboring centers of attraction."

DISCUSSION

THE DISTRIBUTION OF FUNDS FOR RESEARCH

MY attention has been called to the possibility of misinterpretation of a phrase in which reference was made to the Land Grant Colleges in my article on "Science and Prosperity" published in the issue of SCIENCE for November 2. I was discussing the possibility of government support of scientific work on a national scale and the particular question of efficient administration of such funds if they were available. In this connection appeared the sentence: "Perhaps the worst way to carry on research is to distribute funds according to some formula such as that followed in the support of Land Grant Colleges, $50,000 to each State in the Union, or so much to every research laboratory."

Being myself an administrative officer of a land grant college, and believing that the land grant colleges are the backbone of our American system of higher education, I certainly did not intend to imply a criticism of the land grant colleges or of the basis on which they receive federal support. This support was intended to stimulate the program of higher education throughout the country, and particular reference was made to agriculture and mechanic arts. It is true that land grant colleges in less populous states receive the same federal aid as do those in the more populous states, but on the other hand their need of such support is generally greater. However this may be, my statement on the subject was not a criticism of the land grant method of supporting the educational programs in land grant colleges, but was a statement of my judgment that a similar basis would not be an efficient one for the support of a research program whose objective is to secure the maximum scientific and technical development for a given expenditure of time and money. The reasons for this are obvious to those acquainted with the geographical distribution of scientifically trained men.

Perhaps the point which I was trying to make would be illustrated by the following example: Suppose the objective were to shoot as many ducks as possible with a given amount of ammunition. The way to proceed would not be to fire so many volleys in each state of the Union or a volley over each lake in the country, but rather would be first to locate the ducks and then fire at them. Similarly, the objectives of a program like that which I was discussing would best be attained by first locating the big ideas wherever they may be, and then allocating the necessary funds to put these ideas to work.

The only reason for mentioning the land grant college situation explicitly was because some corresponding plan of geographical or proportional distribution of funds might be the first thought regarding its administration, and such a procedure would, I believe, be fatal to the success of any plan aimed at quick and efficient stimulation of scientific work.

KARL T. COMPTON

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE MOTION OF GLACIERS

IN SCIENCE for November 2, 1934, is a discussion by O. D. von Engeln, entitled "The Motion of Glaciers," to which objection should be raised. Its final paragraph reads:

> The above quotation, together with the one given in a preceding paragraph, are enough to permit appreciation of the correspondence of the two interpretations of glacier motion and of the special significance of the salt solution to the required lubrication for inter-grain shifts. They will also serve to make clear how different this concept is from the shear theory, in which it is postulated that glacier motion is: solid flow by idiomolecular exchange between ice crystals, solid shearing of aggregates of granules, intermittent slip along well-developed thrust planes and sliding of the whole body of ice over the rock beneath. Such shear concept Hess, now, and the present author, earlier, hold to be fundamentally and completely erroneous.

The last sentence contains a rather sweeping statement. Let us consider the four sorts of movement which are held to be "fundamentally and completely erroneous."

(1) Sliding of the whole body of ice over the rock beneath. What else could cause the striation, grooving and fluting found on the underlying rock surface? The length and depth of some of the individual scratches would seem to indicate that the rock frag-

ments which cut them were firmly held by the moving ice for considerable lengths of time.

(2) Intermittent slip along well-developed thrust planes. These thrust faults have been photographed by many observers on many glaciers. Intermittent slip along some of them has been shown by automatic instrumental records and is homologous with slips on thrust faults in other rocks.

(3) Solid shearing of aggregates of granules. This small-scale faulting is found to be more prevalent and general than the larger slips on well-developed thrust planes and is a characteristic feature of glaciers.

(4) Solid flow by idiomolecular exchange between ice crystals. This type of movement involves the growth of ice granules together with movement and adjustments (sliding and rotation) between the granules, and is considered to be the underlying basic process in glacier motion. The granules are small in the névé region; they are larger near the glacier terminus, and particularly large in the longer glaciers. In some places near the terminus of the Allen glacier in the Copper River district of Alaska and probably fifteen to twenty miles from the upper snowfields, they average from three to four inches in diameter and locally have been observed up to six inches. It is believed that the névé granules gradually grow as the ice moves down the glacier, the larger crystals at the expense of the smaller, by transfer of molecules. In the process the granules change their positions with respect to one another under changing conditions of pressure and melting, as explained in various text-books in the last thirty years. "The summation of slight adjustments between innumerable granules is general movement of the mass in lines of least resistance. . . . This . . . appears to be the fundamental mechanism by which the motion is accomplished." Rather strange it is that Dr. von Engeln should characterize the concept, which puts first in importance this movement between the granules, as "fundamentally and completely erroneous," when he takes over the idea of intergranular movement as the basis of his own view of glacier motion. His particular addition is the postulate of a liquid film of salt solution which, by lubrication, aids this movement between granules.

Dr. von Engeln has designated this composite picture of glacier motion outlined under headings (1) to (4) as the "shear concept." Shearing plays its part in the complex phenomenon of ice moving down a valley, and its recognition is important for the light which it throws upon the nature of the ice, but it is only one phase of a complicated process. To name the whole concept after but a single factor where other important factors are strongly involved seems open to protest.

Dr. von Engeln states "that a glacier consists of an outer and terminal crust of rigid ice, carried along and shoved forward by a core of interior ice flowing viscously under the pressure of the exterior shell and existing at essentially the pressure-temperature melting point of ice, a temperature which declines with depth (because of the increase of pressure) to the bottom of the glacier. The viscous flow of the interior ice results from the presence of a liquid film of salt solution surrounding and separating the glacier grains. This film acts as a lubricating medium to facilitate the movement of the grains one past the other."

In so far as there may be a small amount of salt between granules of purer ice, melting at such places obviously would be aided and movement of the granules, as discussed above under heading (4), would be facilitated. Thus the salt would seem to act as an additional auxiliary agent increasing the effectiveness of the other processes already mentioned. Careful chemical analyses should reveal how much salt actually is present in the upper part of a glacier starting from a lofty snow summit far inland, how much lowering of the melting point may be expected, and consequently how important an auxiliary factor salt may be.

At the other extreme, J. V. Harrison delights in twitting his friends about a "glacier" in Persia which is all salt, or salt mixed with gypsum. The salt has come up from below as a salt plug and "spills over the alluvium of the plain, where it forms a long tongue-like sheet stretching southwards for fully three miles."[1]

R. T. CHAMBERLIN

UNIVERSITY OF CHICAGO

A TROPICAL FISH CROSS

VARIOUS attempts at experimental crossing of two tropical fishes, the swordtail (*Xiphophorus helleri*) and guppy (*Lebistes reticulatus*) have proved unsuccessful, and there is quite a general belief that these two species are too unrelated or have too dissimilar chromosome formulae for successful mating. To be sure, some aquarists claim to have crossed them successfully, and there are alleged hybrids which are more or less generally discredited as such.

As the matter is of considerable theoretical interest, we wish to record a more successful attempt; and will first summarize what seem to us the important and reasonably certain results obtained; second, discuss the possibilities of error, and, finally, touch briefly on the experiment's significance.

Early in 1933 by crossing with guppy, broods of

[1] James Vernon Harrison, *Quart. Jour. Geol. Soc.*, lxxxvi, 476–85, 1930.

young were obtained (by Mallett), in tanks kept at a high temperature with an abundance of forced air, from three virgin female swordtails, members of a brood that consisted entirely of females and was raised in his tanks. Later these "hybrid" fish were permitted to interbreed, and a total of 10 broods and 100 "hybrid" individuals obtained to date would be a very conservative estimate, though the original swordtail mothers died without again giving birth. The young were not in any way obvious hybrids but swordtails, mostly female swordtails and less than 10 per cent. male swordtails. An exception was the first-born fish of the first-born original-cross brood, which turned out to be a female guppy, quite typically such to outward appearances. At the age of six months this fish developed a crooked spine, and at between 9 and 10 months gave birth to brood of some half dozen young by a "hybrid" male swordtail, all of which turned out to be swordtails, not guppies.

The parentage of the original crosses seems irrefutable. The swordtail females used were about 18 months old, to be sure, when bred, but there had been no male swordtail or live-bearers other than guppies in the Mallett tanks for a year prior to the birth of their young. That the above-mentioned female guppy was a *bona-fide* member of one of the same broods can hardly be doubted. Its birth was observed (Mallett) and its growth watched from day to day. In the beginning noticeably larger and different from its brood-mates, they grew more rapidly and exceeded it in size. That this guppy gave birth to a brood of swordtails is only reasonably certain. From lack of space it was temporarily confined while pregnant in a tank with young "hybrid" swordtails, and when its own brood appeared, contrary to expectation they could not with certainty be differentiated from the smallest of these, hence the young were allowed to grow up together and all turned out swordtails.

The results obtained call to mind those described by Hubbs and Hubbs[1] for one of the live-bearers, for which they suggest gynogenesis as explanation, later questioned by Howell.[2] If gynogenesis does exist in these fishes it might reasonably be looked for in the present "cross." Nor would the female guppy be entirely out of line with such an explanation if we suppose some chance somatic determinant as well as germinal stimulus to have been received from the male parent without his chromosomes being accepted in the normal way.

GUY C. MALLETT
J. T. NICHOLS
AMERICAN MUSEUM OF NATURAL HISTORY

NEW DISTRIBUTIONAL RECORD FOR THE MEDUSA CRASPEDACUSTA

ON the evening of July 25, 1934, a trip was made to a small artificial pond located near the city limits of Dallas, Texas. Much to my surprise, the water of the pond was teeming with the medusae of *Craspedacusta ryderi* (Potts). A single scoop with a pint jar yielded sixteen that varied from 6 to 12 mm in diameter.

On the following day another trip was made to the pond with the necessary equipment for a general survey. The pond, which is two years old, covers approximately one acre and is three and one half feet deep. The water supply is obtained from a Dallas city main and runs in constantly, although during this excessively hot, dry weather there is very little overflow, since evaporation is almost equivalent to the inflow. The pond is well stocked though not crowded with water-lilies, which were purchased from Texas and New Jersey nurseries. The lily-pads and stems are covered with dense growths of algae. Examinations of plankton samples revealed an abundance of ostracods, copepods, rotifers and infusoria, thus insuring sufficient food for the medusae. The pond is also inhabited by goldfish and green sunfish.

Wading among the lily-pads stirred up the "ooze" on the bottom, and in areas where the medusae had not heretofore been visible such riling of the water caused them to appear by the thousands. A close field examination of lily-pads and stems with a hand lens and microscopic examination in the laboratory of scrapings from the vegetation and sides of the pond have failed to reveal the hydroid generation. On the third of November the medusae were still abundant. The cycle will be carefully followed, and it is hoped that eventually the hydroid generation will be found.

According to Bennitt's (1932) summary[1] of the American records of *Craspedacusta,* the present report brings the total number of states from which they have been recorded up to eleven, and Texas is the third state west of the Mississippi from which it has been reported.

ELMER P. CHEATUM
SOUTHERN METHODIST UNIVERSITY

SOCIETIES AND MEETINGS

SUMMER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

THE fortieth summer meeting of the American Mathematical Society was held at Williams College, Williamstown, Massachusetts, from September 4 to 7. This was the second meeting of the society at Williamstown, the first having been held in 1905. The Mathematical Association of America, which met in

[1] SCIENCE, n. s., 76: p. 628, 1932.
[2] SCIENCE, n. s., 77: p. 389, 1933.

[1] *American Naturalist,* 66: 287–288.

conjunction with the society, held its sessions on Monday afternoon and Tuesday morning.

The principal feature of the meetings was the seventeenth of the series of colloquium lectures delivered under the auspices of the society. The lectures were delivered by Professor Norbert Wiener, of the Massachusetts Institute of Technology, on the subject "Fourier Transforms in the Complex Domain." Professor Wiener delivered four lectures of an hour and a quarter each, one on Tuesday afternoon and the others on Wednesday, Thursday and Friday mornings. The first lecture was devoted to Fourier transforms in strips and half planes, the second to quasi-analytic functions, the third to closure properties of trigonometric functions, while in the fourth the lecturer discussed the harmonic analysis of random functions. The material of these lectures was the outgrowth of a fundamental and far-reaching series of investigations carried on by Professor Wiener and Dr. R. E. A. C. Paley, of Cambridge University, while the latter was spending a year at the Massachusetts Institute of Technology. Dr. Paley was killed in an unfortunate skiing accident while on a brief vacation in the Canadian Rockies in April, 1933.

On Thursday afternoon, by invitation of the program committee, Professor J. A. Shohat, of the University of Pennsylvania, gave an address entitled "On the Expansion of Functions in Series of Orthogonal Polynomials."

Of the shorter papers read before the society at its various sessions, twenty were devoted to analysis, four to geometry and analysis situs, seven to algebra and two to mathematical logic. In addition, twenty-six papers were read by title, eleven in algebra and number theory, nine in geometry and analysis situs and six in analysis.

The local committee arranged a delightful program for the visiting mathematicians and their friends. Wednesday afternoon was featured by an automobile trip over the Taconic Trail to Bennington Battlefield and the new Bennington College for Women. On Wednesday evening a very fine organ and song recital was given by Dr. and Mrs. Charles Louis Safford. Dr. Safford is the director of music at Williams College. On Thursday evening the banquet of the mathematical organizations was held at the Hotel Greylock. Professor E. V. Huntington acted as toastmaster. The speakers were: Dr. Tyler Dennett, the new president of Williams College; Professor Arnold Dresden, representing the Mathematical Association, and Professor E. R. Hedrick, representing the society.

J. R. KLINE,
Associate Secretary

DENTAL CONFERENCE AT YALE UNIVERSITY

A GROUP of fifty dental surgeons from various parts of the country met at the Yale University School of Medicine on October 24 and 25 for a discussion of scientific subjects relating to dentistry. Dr. A. Leroy Johnson, of New York City, presented a paper on studies of the teeth and jaws of dogs from the Cornell Experimental Morphology Farm. He described tooth defects found in certain cross-breedings in dogs fed adequate diets and showed the similarity to defects which have been shown to be associated with dietary deficiencies. The importance of genetic factors in research on the teeth was further emphasized in the discussion of the paper.

A clinical study of restorative work on the teeth from the point of view of the effect on the health of the individual in subsequent years was described by Dr. Yngve Hildebrand, of the Royal Institute of Stockholm, Sweden. Advantages and disadvantages of restorations as evidenced in a number of individuals over a period of eight to ten years were analyzed. Stresses upon the teeth, bone and other supporting tissues, and the results of these stresses were noted in detail. Dr. Hildebrand illustrated his discussion with clinical and statistical material derived from his study of the subject for the past twelve years.

A report on a study at Yale on nutrition and dental changes was presented by Professor Arthur H. Smith, Miss Aline U. Orten, Dr. Casper C. Burn and Dr. Sumter S. Arnim. One aspect of the study had to do specifically with the influence upon the teeth and related structures in rats of a diet deficient in inorganic salts. The investigation showed in general that the skeletal bone and the tooth structure respond in different ways and in different degrees to the same dietary factors. A presentation was also made of a series of patients to show medical-dental relationships in diagnosis and treatment. Cases from Yale were presented by Dr. B. G. Anderson, director of clinical work in dentistry, and Dr. David Weisberger, with the collaboration of staff physicians. Case reports were made also by Dr. J. C. Healy, of Tufts Dental School. A demonstration and discussion of laboratory work being carried on by the dental group at Yale was conducted by Professor Smith and Dr. Burn with the assistance of Dr. Lester Burket, Dr. Frank Kanthek and Dr. Harold Genvert.

The purposes of the dental program at Yale were described as: (1) To place the study of the natural history of the teeth in health and disease on a sound scientific basis; (2) to investigate the causes of diseases of the teeth and associated structures in relation both to specific agents of local morbidity and to the general health of the individual; (3) to create a

liaison between dental and medical personnel by developing a group of men for the interpretation of diseases of the teeth and their relationship to the functioning of the human organism as a whole.

Dr. M. C. Winternitz, dean of the Yale University School of Medicine, spoke on the dental project at a dinner meeting of the group. Subjects relating to dental education were further discussed by Dr. George R. Moore, of Ann Arbor, and Dr. Frank S. Cartwright and Dr. Stanley A. Mackenzie, of Detroit.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

LITHOTYPING IN MINIATURE AS A MEANS OF SCIENTIFIC PUBLICATION

THIS is a further note on a method of inexpensively publishing research reports, which Dr. Seidell and Dr. Visscher discussed in earlier numbers of SCIENCE (July 20 and September 14, 1934).

During the past three years we have developed in the School of Education at the Pennsylvania State College a scheme of lithotyping in miniature doctors' dissertations and abstracts of theses. We have so far issued three numbers of such publications and shall issue three more this year. In the case of a doctor's dissertation we prepare an abstract eight or ten pages in length giving a summary of the procedures and findings, lithotyping this in a size of type that can be easily read without a magnifying glass. Then we lithotype in miniature the whole dissertation, including unabridged tables, graphs, etc. The miniatured pages are 1.9 by 2.4 inches, and eight of then fit into a five- by eight-inch book page. It is the intention to have this miniatured material read by the aid of a magnifying glass, although it is feasible to read it without such aid. Two very suitable reading glasses for this purpose are available: one is a binocular reading glass developed by the author from a stereoscope, the cost of which is only $3; the other is the "electrolens," manufactured by the American Optical Company, containing a small electric light for illuminating the page, and selling at wholesale for $5.

A doctor's dissertation, consisting originally of 120 typed pages, put up in this form made a booklet of 24 lithotyped pages—a nine-page large-type abstract, twelve pages of miniatured material, and one inside and one outside cover page blank. The cost of lithotyping, assembling and stitching these was $42 for an edition of 500. The booklets could be sent through the mail at one-cent postage.

Our abstracts of masters' and doctors' theses are put up in the following manner: each abstract occupies the front and the back surfaces of a single sheet, five by eight inches in size; on the front face a brief abstract of the whole thesis is given in type large enough to be read by the unaided eye; on the back surface occur eight miniatured pages for which a reading glass should be used. Thus each abstract contains the equivalent of an eight- or nine-page journal article, although it occupies but a single sheet five by eight inches. Each abstract carries a filing number according to the system of the *Loyola Educational Digest*. For libraries we have these sheets bound into booklets with a spiral wire coil. Those not to be used on library shelves are left unbound and are trimmed to fit into a standard filing system so that they may be kept classified by topic.

An edition of seven hundred copies of these abstracts containing eighty pages costs us about $127 for the lithotyping and in addition $50 or $75 for overhead.

Not only is this an inexpensive way to publish research reports, but there is the further advantage that the miniatured material occupies only a small amount of shelf space in libraries, as compared with ordinary print. This is an important factor if we are to come to the policy of publishing large numbers of research reports. And, when a suitable glass is used, miniatured print can be read approximately as easily as regular type.

CHARLES C. PETERS

ATTACHING REFRACTORY PARAFFINE SECTIONS TO THE GLASS SLIP

IT often happens that a protective, permeable covering for sectioned tissue on the slip is needed to prevent possible transposition of certain structures, the loss of refractory sections, or to permit drastic manipulations, such as blotting sections or passing them from aqueous stains to 95 per cent. alcohol. By following the suggestion of Barron[1] that amyl acetate is a practical solvent of both paraffine and celloidin, a protective membrane meeting the above requirements has been devised. By this method fine cytological, as well as very difficult material, such as cross-sectioned rabbit fur and vibrissae, may be securely fastened to the slip, successfully stained and covered.

Two solutions are made as follows:

(A) To equal parts of absolute alcohol and ether add enough liquid collodion (U. S. P., Baker) to make a solution so thin that when a glass slip is flooded and the solution permitted to coagulate, the mark of a sharp needle is scarcely visible to the unaided eye. (Thicker solutions may be used on thick sections or on those not intended for study under oil immersion.)

(B) Add one volume of amyl acetate ("purified," Baker) to four of solution A. (In practice the propor-

[1] D. H. Barron, *Anat. Rec.*, 59: 1–3, 1934.

tions may be estimated and the solution made in a 10 ml. vial.)

Because of the small quantity used and the highly volatile nature of solution A and the relatively wide range in strength which may be employed in either solution, an exact formula is not necessary. The tendency is to make the solutions too thick. Best results are obtained with freshly prepared solutions. It should be remembered that solutions A and B are soluble in 95 per cent. alcohol. Whether Mayer's albumin or water alone is used in stretching the sections is immaterial.

After the stretched sections have been thoroughly dried each slip is flooded with solution B and placed face up on a level surface for half an hour, or until the sections are sufficiently free of paraffine to appear nearly clear. Then, two or more layers of fine filter paper (Munktell's No. 3 is excellent) are placed over the tissue and rolled vigorously with a smooth bottle to absorb the surplus solution and flatten any sections which may have buckled. The sections are immediately flooded with solution A and the slip stood on end against a staining jar until the celloidin attains a glistening surface and toughened texture. The slip is then placed in 70 per cent. alcohol for several minutes, then passed rapidly (to prevent loss of the celloidin) through 95 per cent. alcohol and into carboxylol, where it should remain several hours, or be placed into xylol, to remove the paraffine. The slip is passed from carboxylol through 95, 70 or 50 per cent. alcohol to water and stained. After being stained and cleared in carboxylol the sections should remain in xylol sufficiently long (24 hours is not injurious) to insure removal of all remaining paraffine.

By replenishing, and thus prolonging, the application of solution B the sections may be passed from 70 per cent. alcohol to water and stained, instead of going to carboxylol before being stained. In general this shorter method is not recommended, for staining is often faulty due to incomplete removal of paraffine from the sections.

This method lends itself admirably to routine work in preparing numbers of slides. To facilitate handling a considerable number of slips the writer uses $1 \times 4 \times 12$-inch soft pine boards, each of which easily accommodates ten slips. Such a board of slips is placed upon an empty board, which raises the slips nearly two inches above the table top, and each slip is then flooded with solution B. Five of the ten are blotted at one time, hastily flooded with solution A and slanted against the two boards to allow the solution to drain and evaporate to the proper consistency before the slip is placed in 70 per cent. alcohol.

The celloidin film employed in this method does not retain stains as does that to which clove oil has been added. Preliminary experiments showed that with iron hematoxylin three-hour mordanting and three-hour staining, or three-hour mordanting and twenty-hour staining, the stain in the film was removed by iron alum solution before sections of striated muscle were properly destained. Mann's eosin-methyl blue was retained by the celloidin nearly as readily as by the sections of nerve trunk tissue, but the depth of the stain was not great enough to be objectionable. Mallory's phosphotungstic acid hematein ammonium staining method did not discolor the celloidin in over a hundred slides of rat tissues.

EDWARD D. CRABB

UNIVERSITY OF COLORADO

SPECIAL ARTICLES

LAKE VEGETATION AS A POSSIBLE SOURCE OF FORAGE*

THE past summer, with its high temperatures and low rainfall, has accentuated the drought conditions which for the past several years have been more or less prevalent over considerable portions of the Great Plains Region. The ground water table has been generally greatly lowered throughout the region. Many lakes and streams have either disappeared or have dwindled to a remnant of their former size, and in many areas there is insufficient forage to maintain through the winter even the reduced number of live stock which remain in the area. In certain areas all local forage of every kind has already been consumed.

In the glaciated area of this region there exist tens of thousands of lakes. Many of these under the influence of deficient rainfall have become shallow and large areas of them are literally choked with masses of lake vegetation. Other deeper lakes have large shallow encircling areas or bays in which a rank growth of lake "weeds" is present.

It occurred to the writer that perhaps such lake vegetation might be utilized as a source of forage in the present emergency and, in fact, might represent a new natural resource which could contribute to the future agricultural wealth of the region. Accordingly, samples of the dominant vegetation types were collected during September and early October from representative Minnesota lakes, including both those with sand and mud bottoms. Those samples were analyzed with the results shown in Table I. In Table

* Paper No. 1313, Journal Series, Minnesota Agricultural Experiment Station.

TABLE I

ANALYSES OF SAMPLES OF LAKE-WATER VEGETATION FROM REPRESENTATIVE MINNESOTA LAKES[1]

No.	Dry matter content Per cent.	Dry basis analyses: Ash Per cent.	Crude protein Per cent.	Ether extract Per cent.	Crude fiber Per cent.	N-free extract Per cent.
1	13.6	20.26	17.65	1.28	11.15	49.66
2	.....	17.08	17.53	1.21	14.93	49.25
3	.....	17.08	17.34	1.65	13.19	50.74
4	22.7	18.29	13.68	1.45	23.01	46.03
5	.....	38.75	10.41	0.91	16.52	33.41
6	.....	30.17	12.26	0.87	17.69	39.01
7	.....	13.03	19.03	1.36	19.36	47.22
8	.....	18.38	11.49	2.07	22.63	45.43
9	14.2	22.84	14.44	1.82	15.20	45.70
10	14.6	17.26	12.72	3.08	17.59	49.35
11	.....	23.90	13.62	2.18	18.70	41.60
12	.....	21.76	14.11	1.13	21.04	41.96
13	.....	18.39	13.38	2.75	22.65	42.83
14	18.4	27.86	12.13	1.71	16.20	42.10
15	14.4	22.89	19.25	2.36	12.30	43.20
16	.....	23.69	15.74	2.50	20.73	37.34
17	14.2	20.21	14.81	1.44	17.51	46.03
18	.....	28.63	15.03	1.29	18.26	36.79
19	.....	28.44	13.29	1.27	13.67	43.33
20	.....	7.95	17.03	2.79	13.75	58.48
21	.....	30.37	5.21	0.78	15.23	48.41
22	.....	14.85	18.92	1.92	18.69	45.62
23	.....	14.98	13.01[2]	1.17	17.42	53.42
24	.....	16.93	13.94	2.22	18.28	48.63
25	10.8	12.60	14.75	.....	21.56	51.09[3]
26	16.9	13.66	13.90	.....	22.38	50.06[3]
27	15.4	14.91	13.72	.....	22.49	48.88[3]
28	15.0	17.63	14.60	.....	20.34	47.43[3]

No.
1–3. *Myriophyllum spicatum* (water millfoil).
4–5. *Potamogeton amplifolius* (large leaved pond weed).
6. *Potamogeton Richardsonii* (Richardson's pond weed).
7. *Potamogeton pectinatus* (Sago).
8. *Potamogeton zosteraefolius* (eelgrass).
9–13. *Najas flexilis* (Naiad).
14. *Elodea canadensis* (water thyme).
15–17. *Ceratophyllum demersum* (hornwort).
18. *Vallisneria spiralis* (water celery).
19. *Heteranthera dubia* (water star grass).
20. *Nymphaea advena* (yellow pond lily).
21. *Chara* sp.
22. *Ruppia occidentalis* and *Potamogeton pectinatus*.
23. Largely *Myriophyllum spicatum*.
24. Largely *Najas flexilis*.
25. Largely *Elysma plantago-aquatica* (water plantain).
26–28. Random mixed sample.

TABLE II

AVERAGE PROXIMATE ANALYSIS OF THE DRY MATTER IN REPRESENTATIVE FORAGES[4]

Type of forage	Ash Per cent.	Crude protein Per cent.	Crude fiber Per cent.	Carbohydrates and fat Per cent.	Number of analyses
Corn fodder	7.14	8.57	29.8	54.4	56
Sorghum fodder	8.64	8.2	28.9	54.2	22
Kentucky blue-grass	7.6	9.56	32.6	50.2	26
Timothy	5.5	7.0	33.7	53.7	221
Sudan grass	7.9	9.26	30.4	52.4	44
Prairie hay	8.2	8.55	32.6	50.3	42
Alfalfa hay	9.4	16.3	31.0	43.3	250
Cow-pea hay	12.96	21.4	24.9	40.5	35
Soy-bean hay	9.4	17.5	27.2	45.8	23

II are shown corresponding analyses of the commonly used forage plants.

It will be observed that with but a single exception (*Chara* sp.) the lake vegetation is characterized by (1) a high ash content, (2) a high protein content and (3) a very low "crude-fiber" content, and that the legume hays are the only commonly used forages which even approximate the lake weeds in these constituents. The *Chara* sp. was analyzed simply from curiosity. It does not ordinarily occur in any great abundance and was found growing in very shallow water on a sandy beach.

Preparation for Analysis. The plants were brought to the laboratory soon after collecting, washed with tap water from a hose while whirling them in a perforated basket centrifuge. The whirling in the centrifuge was continued until the surface moisture had disappeared. The green weight was then taken and the samples dried in a current of air at about 65° C.

The Dry Matter Content. The table shows that the dry matter content can be expected to range from 13.6 to 22.7 per cent. of the green weight of the plants (excepting the leaves of the water plantain and perhaps other lily forms). These values approximate what might be expected of succulent upland grasses.

The Ash Content. The ash content of the lake vegetation is unusually high for forage plants. However, many of the lake plants are marl-formers and

[1] Botanical identification was kindly made by Dr. C. O. Rosendahl of the Department of Botany, University of Minnesota.

[2] Dried as "hay" in the open. Subjected to severe rains during curing.

[3] Includes "ether extract."

[4] Calculated from data in "Feeds and Feeding," by W. A. Henry and F. B. Morrison. The Henry-Morrison Company, Madison, Wis. (1923).

he ash is composed to a very considerable extent of ime, in part deposited as incrustations on the surface f the leaves and stems. In the high-ash samples of *Potamogeton* and *Chara* the lime incrustation was specially marked. It is generally recognized that the ereal grains are deficient in calcium, so a high-lime orage should admirably supplement such feeds.

The "Crude Protein." With the exception of the *Chara* sp. the "crude protein" of all samples compares favorably with the "crude protein" content of egume hays. No great species differentiation is seen n the protein content, neither does the "crude protein" content differ markedly between samples of the ame species collected from mud-bottom and sand-ottom lakes. It seems probable that the high "crude rotein" content is the resultant of an unusually avorable environment. The best top soil of the vicinty washes into the lake, therefore the lake bottom hould possess high fertility. In addition the nitrates rom the surrounding lands wash into the lake with he drainage water and provide continuous fertilization. Lastly microscopic forms of life and the lake auna die and decompose and their nitrogen contributes to the fertilization of the plants.

The "Crude Fiber." The crude fiber represents the ellulose and other supporting elements of the plant. n every instance it is lower than the average analyses f the conventional forage crops. The low fiber content is presumably due to the fact that the lake plants lo not need supporting structural elements—the buoyancy of the water serving in place of cellulose strands.

The Feeding Value. Literature on the feeding value f water vegetation is apparently extremely meager. *Elodea canadensis* has been reported by both German[5] and Holland[6] workers to be an excellent food for cattle and swine, being fed either green or as ensilage. Apparently no other forms have been tudied. There is, however, no *a priori* reason to suspect that many of the types of lake vegetation will not serve as suitable feeding stuffs. The analyses ppear to indicate that they may be superior to much f the forage which is now used on farms in the Great Plains area.

Representative bulk samples have been collected, nd their feeding value, including palatability, vitamin content, digestibility, protein quality, nitrogenous constituents, types of carbohydrate present, etc., will be studied in these laboratories during the coming winter. If the drought conditions should continue through another year the lakes of the glaciated region may provide the necessary forage.

In any event, the uniformly high "crude protein" content of lake vegetation suggests the possibility of growing suitable non-leguminous plants in our shallow lakes and preparing therefrom what is essentially a "concentrate" for animal feeding. The high-protein, high-lime, low-fiber meal may well become an article of commerce.

It is generally recognized in the thickly populated areas of Asia that "an acre of water will produce more human food than an acre of land." Aquiculture, in suitable areas, may well become a part of our changing agriculture.

[5] F. R. Ferle, *Fühlings. Landw. Ztg.*, 53: 549–58, 1904.
[6] Anon., *Bull. Agr. Intelligence*, 9: 1079–80, 1918; *Jour. Board Agr.* (London), 26: 321–2, 1919.

Addendum

Since writing the above the analyses of certain aquatic plants by H. J. Harper and H. A. Daniel (*Bot. Gaz.*, 96: 186 (1934)) has appeared. These authors note that aquatic plants are likely to have a higher nitrogen content than upland vegetation but make no suggestions of the possibility of using aquatic plants as a source of forage.

Ross Aiken Gortner
The University of Minnesota

THE STRUCTURE OF THE CARDIAC AGLUCONES

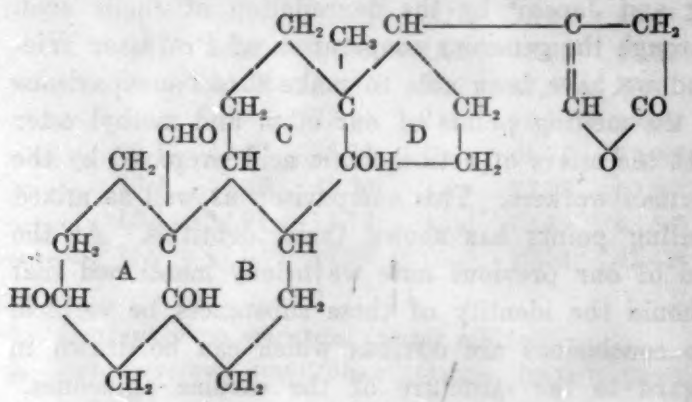
In our recent preliminary note in Science[1] we have described the degradation of digitoxigenin to an acid, $C_{20}H_{32}O_2$, which corresponded in properties with aetiocholanic acid obtained by Wieland, Schlichting and Jacobi[2] by the degradation of cholic acid. Through the generous cooperation of Professor Wieland we have been able to make direct comparisons of the melting points of our ethyl and methyl ester with the esters of aetiocholanic acid prepared by the German workers. This comparison as well as mixed melting points has shown their identities. At the end of our previous note we briefly mentioned that "should the identity of these substances be verified, the conclusions are obvious which can be drawn in regard to the structure of the cardiac aglucones." Shortly after our note appeared, the current number of *Angewandte Chemie* reached us, which contains a preliminary article by R. Tschesche[3] on the similar degradation of another cardiac aglucone, uzarigenin. The appearance of the latter requires that we be more explicit in regard to the conclusions which can be drawn from our work.

Tschesche has succeeded in degrading uzarigenin likewise to an acid, $C_{20}H_{32}O_2$, which, however, did not prove to be aetiocholanic acid but appeared from the melting points of the acid and its ester to be identical with aetioallocholanic acid obtained by degradation of hyodeoxycholic acid. These results simul-

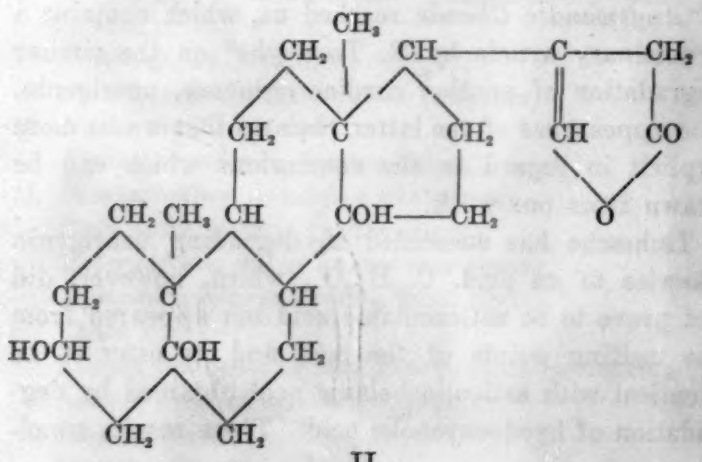
[1] W. A. Jacobs and R. C. Elderfield, Science, 80: 434, 1934.
[2] *Zeits. physiol. Chem.*, 161: 102, 1926.
[3] *Angewandte Chem.*, 47: 729, 1934.

taneously secured in both laboratories thus complement each other and bring confirmation in regard to the identities of the degradation acids obtained from digitoxigenin and uzarigenin. These observations furnish for the first time conclusive evidence that the cardiac aglucones possess the sterol ring system, a fact already strongly indicated by the production of methyl cyclopentanophenanthrene by selenium dehydrogenation. At the same time it is conclusively shown that the unsaturated side chain of these aglucones is a fragment of the sterol side chain on carbon atom 17.

According to the structure of the sterols now generally accepted, this will require a revision of the partial formulas of strophanthidin and related aglucones which we had tentatively adopted. This structure now requires that the aldehyde group of strophanthidin is situated on a quaternary carbon atom. If this be accepted, the only satisfactory arrangement of the hydroxyl groups in accordance with the interrelationships established by the long investigations of our laboratory requires a formula as given in I for strophanthidin.[4] The formulas of periplogenin, digitoxigenin and gitoxigenin in consequence must be as in II, III and IV. Certain unpublished results add support to this view. Such formulas are now also proposed by Tschesche in the above-mentioned article.

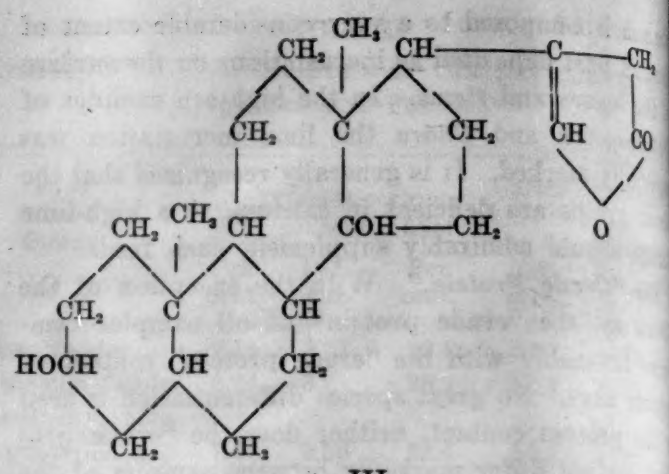


I

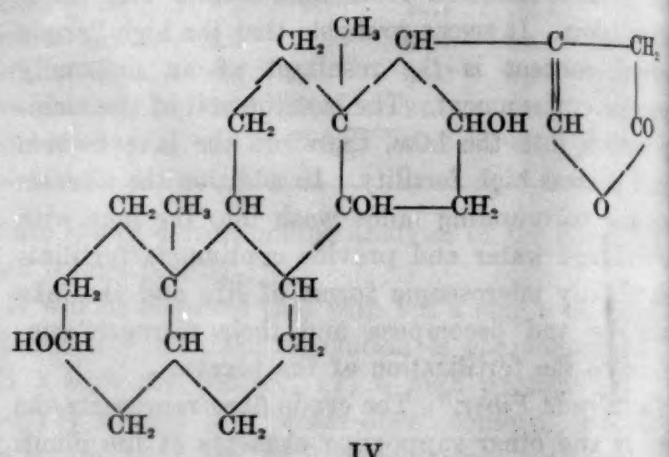


II

[4] Such a formula has already been mentioned among other formulas by Kon in a general theoretical discussion (*Jour. Soc. Chem. Indust.*, 53: 593, 1934).



III



IV

However, there are a number of observations which we have made, both published and unpublished, which appeared to be best explained by the arrangement of the aldehyde group of strophanthidin given in our original formula in which this group is not attached directly to a quaternary carbon atom but to a CH group. Some means of conciliating these observations with the requirements of the new formula will now have to be found.

A complete discussion of these points as well as the presentation of still unpublished work will be left to forthcoming papers in the *Journal of Biological Chemistry*.

Walter A. Jacobs
Robert C. Elderfield

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New York

BOOKS RECEIVED

Hitchcock, David I. *Physical Chemistry for Students of Biology and Medicine.* Second edition. Pp. xi + 214. 28 figures. Charles C Thomas. $2.75.

Smiley, Dean F. and Adrian G. Gould. *A College Textbook of Hygiene.* Revised edition. Pp. xvii + 383. 90 figures. Macmillan. $2.00.

Verdoorn, Fr. *Annales Bryologici.* Pp. viii + 231. 31 figures. Martinus Nijhoff, The Hague. Gld. 6.